SCIENCE

APRIL 21, 1950

ANNUAL BOOK ISSUE

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UNITED NATIONS
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KIRTLEY F. MATHER

THE CHAOTIC UNIVERSITY
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THE QUESTION OF PLASMAGENES
JACK SCHULTZ

THE COMMITTEE ON
FOREIGN COMPENDIA
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COMPLETE TABLE OF CONTENTS ON PAGE 3

VOLUME 111, NUMBER 2886

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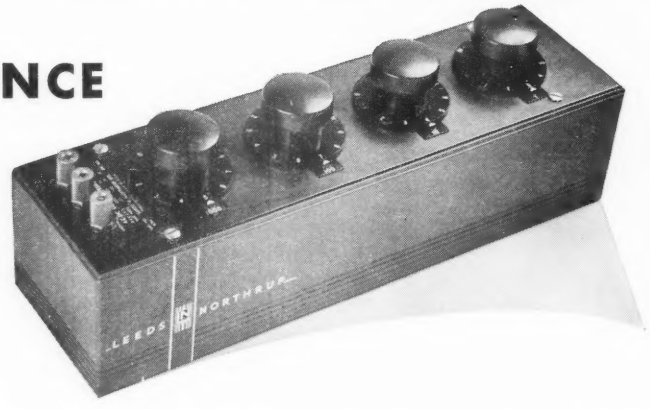
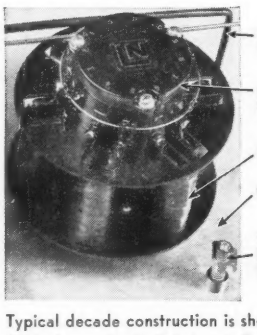


. . . contact resistance starts low and stays low



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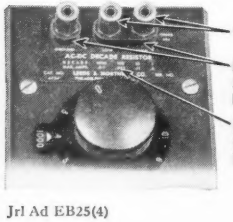

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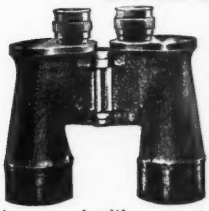

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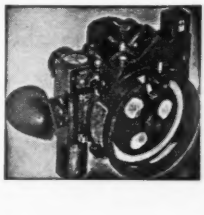

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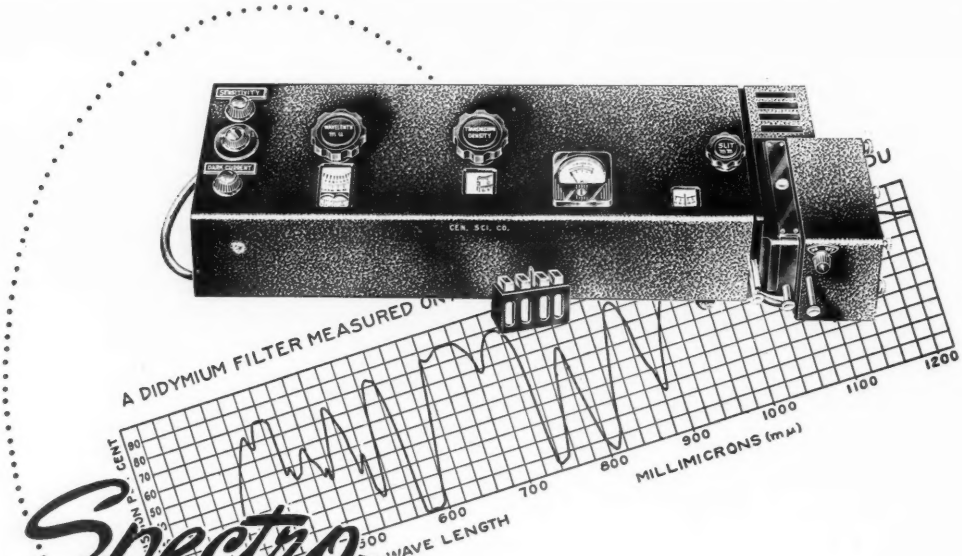

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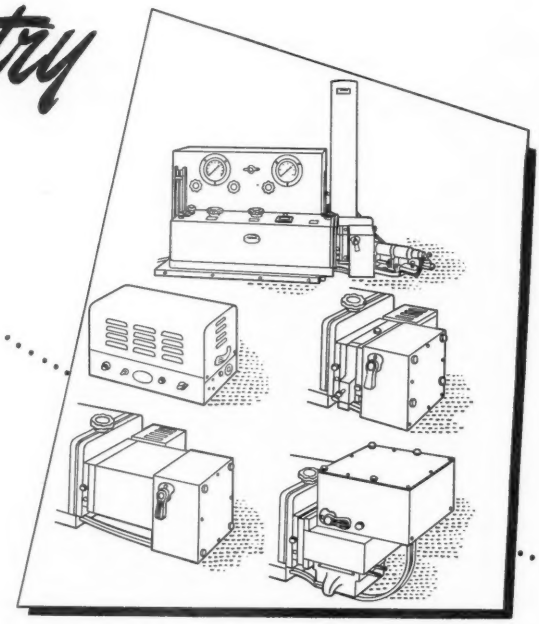

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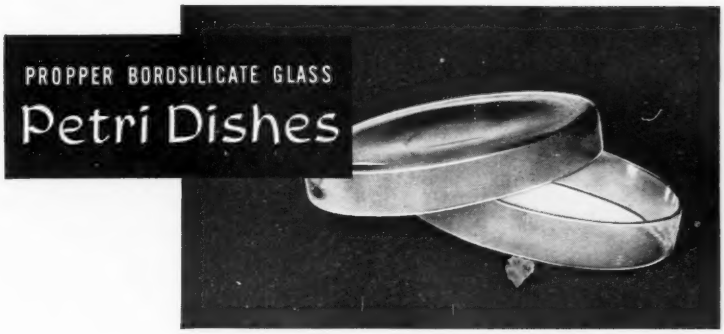

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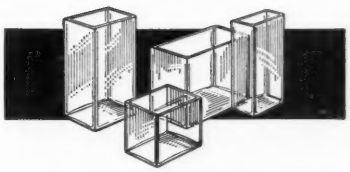

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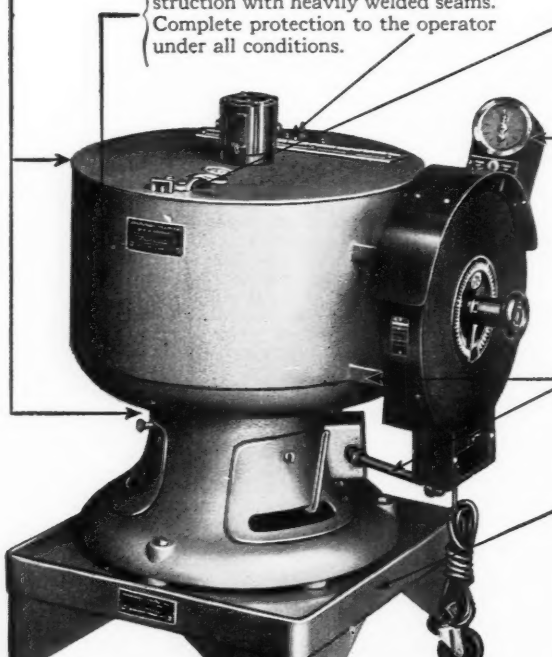

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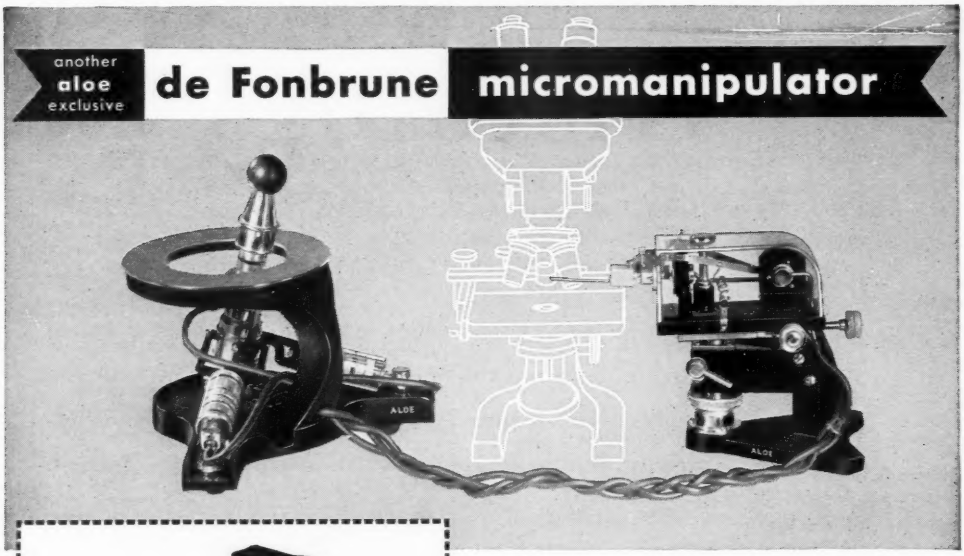

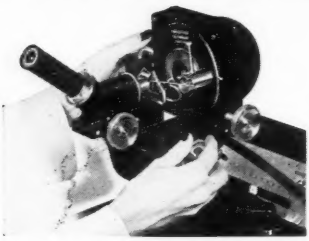

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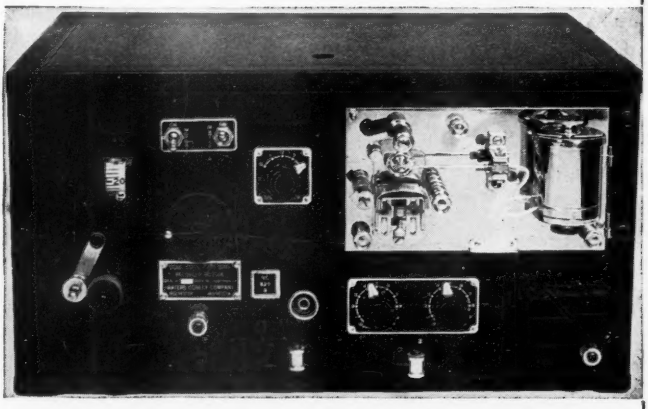

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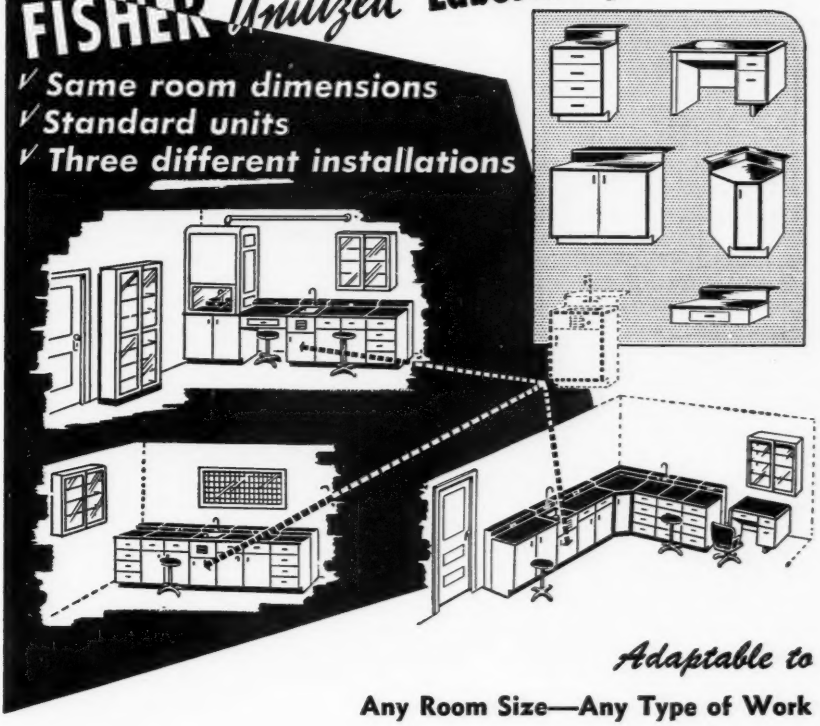

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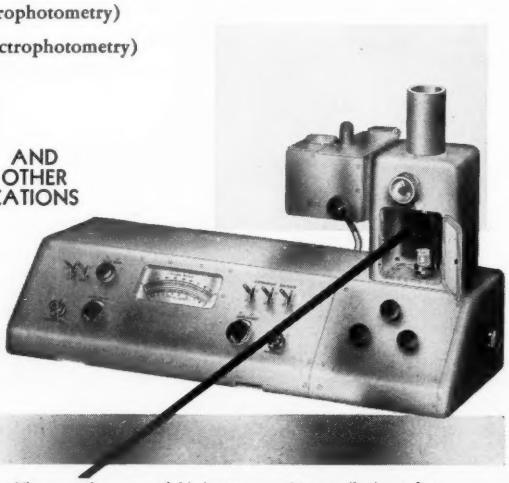

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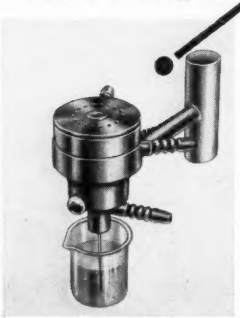

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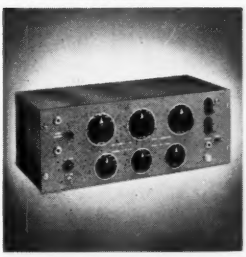

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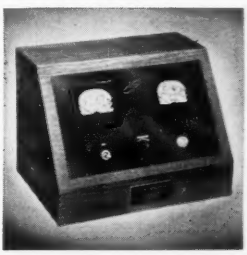

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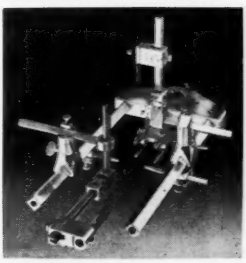

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ALMOST EVERY ADVANCE in science and technology increases the interdependence of men. No nation covers a sufficient variety of geologic structures and includes enough differences in climatic conditions to enable its citizens to secure from within its own boundaries adequate supplies of all the diversified raw materials essential to efficient, comfortable existence in an "age of science." The geologic history of the earth has been such as to make our planet far more favorable for occupation by human beings who arrange for the free flow of goods and services, material resources and finished products, information and ideas, the world around than for habitation by men who insist upon erecting barriers along boundary lines drawn on maps. Details of interdependence will change from time to time, but interdependence itself will continue to be inescapable as far into the future as we can see.

Men of science have long recognized this fact, either consciously or unconsciously, and have attempted to govern themselves accordingly. International organizations of scientists have been established in almost every field of investigation. During the last half-century, hundreds of international gatherings of scientists have been held. The value of free exchange of ideas and the wisdom of coordinated activity have been abundantly demonstrated. Only the politicians and the ignorant insist upon the maintenance of secrecy concerning the results of basic research or the establishment of a party line to direct and confine the minds of men.

It is therefore entirely in keeping with the best trends in recent intellectual developments that certain agencies of the United Nations should be giving careful consideration to the question of establishing research laboratories under world-wide international auspices. The idea was first formally proposed by the French delegation at the meetings of the Economic and Social Council of the United Nations in October, 1946. After extended debate the Council adopted a resolution "inviting" the Secretary-General to consult Unesco and the other specialized agencies concerned and to submit a general report on the problem of establishing United Nations Research Laboratories. That report, with its supporting documents, is embodied in the publication now under review.[1] With it is included a statement of the action taken by the Economic and Social Council in August, 1948, requesting the Secretary-General to form "a small committee of experts in the basic sciences (exact, natural and social) to examine, in consultation with the specialized agencies, the question" and consider appropriate procedures that might be taken in the next few years.

The "committee of experts," on which the United States was represented by Harlow Shapley, past president of the American Association for the Advancement of Science, and Rensis Likert, of the University of Michigan, met in Paris last August and had before it almost a hundred specific proposals. Its formal report has not yet been issued. According to *Nature*, December 31, 1949,

> . . . it is understood that in appraising these proposals the Committee laid considerable emphasis on the value of each project to humanity, from a scientific and a practical point of view, on the appropriateness of the project for research at an international level, on the resources available, the probable cost, the risk of duplication and on whether the project is in an underdeveloped field greatly in need of stimulation. Three projects were selected by the Committee as of first importance: an International Computation Centre, an Institute for Neurophysiology, and an Institute of the Human Sciences. The first and last of these were recommended for immediate establishment by the National Research Council of the United States Committee on Unesco.

The whole project is therefore one concerning which all American scientists should become thoroughly informed. Present plans call for a conference of fifty or sixty scientists during the summer of 1951 for further examination of plans and procedures. The Committee on Unesco of the U. S. National Research Council, now under the chairmanship of Maurice Visscher of the University of Minnesota, who recently succeeded Bart Bok in that position, is rightly urging that there be careful consideration and widespread discussion of the proposals in order that the United States repre-

[1] *The Question of Establishing United Nations Research Laboratories.* Lake Success, N. Y.: Department of Social Affairs, Unesco; New York City: Columbia Univ. Press, 1949. 290 pp. $2.00.

sentatives may have clear guidance at that assembly. The report now under review is the basic document for preparatory study.

Typical of many governmental and United Nations documents, the greater part of this publication consists of "annexes." Here one finds the correspondence between Trygve Lie, Secretary-General of UN, and the executives of such specialized agencies as the Food and Agriculture Organization, the International Labor Organization, Unesco, and the World Health Organization. Unesco's report runs to 74 pages and embodies the appraisals and proposals submitted by many national delegations or commissions, as well as the conclusions and recommendations of the Unesco secretariat. It is a document of extraordinary interest and great importance. Careful attention is given to the criteria that should be used in determining the fields in which international effort is desirable. Such principles as the "ripeness of problems," remoteness from the main research centers of the regions where scientific problems must be studied, transcendence of national boundaries, and the necessity for pooling results internationally, are ably presented.

Another annex contains the replies from the International Council of Scientific Unions and from its constituent organizations, the international unions in the fields of astronomy, geodesy and geophysics, chemistry, radio science, physics, geography, and biology. There is also a record of correspondence and consultation with a large number of other scientific organizations and individual scientists. Finally, there are five special papers submitted by individuals, each of whom presents some excellent ideas concerning research projects that might be undertaken as an international enterprise.

The majority of those consulted were in hearty agreement with the general principle of establishing United Nations research laboratories and presented numerous arguments in its favor. There were, however, some negative arguments. At the time of discussion of the initial proposal made by the French delegation to the Economic and Social Council, the delegations from the USSR and the Ukraine expressed their full approval of international scientific cooperation but favored the "strengthening of national research laboratories and concluded that international scientific cooperation could best be achieved through this means and through the improvement of international exchange of research findings." A similar point of view was later expressed by certain of the American correspondents whose replies are printed in Annex III. An awareness of this argument is implicit in the Unesco statement concerning the basic principles that should determine the criteria for selection of research projects, to which I have made reference.

The other objections referred chiefly to problems of a material and presumably temporary nature. The problem of scientific personnel, for example, presents some very difficult angles. Institutes and research centers are even now multiplying throughout the world at a faster rate than the scientists can be trained to staff them. National scientific developments, particularly in the smaller nations, would be weakened or retarded if valuable personnel were drawn from them to new international centers. On the other hand, the new centers might well be organized in such a way as to provide much-needed training facilities which would soon help the small nations to expand their corps of experts. Any way one looks at it, the bottleneck of limited numbers of adequately trained scientists and engineers appears to be one of the most serious obstacles in the path of progress toward more universal sharing of the benefits of modern science and technology. Although we Americans may well be proud of recent steps, such as the Fulbright fellowships, designed to break through that bottleneck, there is much more that needs to be done, at both the national and the international level.

The most frequent objection, however, was based on consideration of the expenses that would be involved. Existing research institutions are everywhere appealing for additional financial support. It is quite natural to fear that the establishment of central laboratories might be disadvantageous to them. There were numerous suggestions that the United Nations put large new credits at the disposal of laboratories and research institutes throughout the world where problems of international significance are already being tackled by well-qualified teams of research workers. There is no necessary antagonism between the two ideas, other than the inevitable competition for limited funds, should both be adopted. One cannot refrain from cheering the suggestion that a fraction of the money now being spent by many nations upon competitive armaments could better go to the constructive projects envisioned by those who are giving attention to the potentialities of modern knowledge as a tool for improving human welfare.

The relationships between the proposed United Nations research laboratories and existing international bodies committed in whole or in part to the advancement of science present many obvious problems. Unesco, of course, supports the proposals and presumably would be charged with much of the responsibility for carrying them through. The International Labor Organization stresses the value of the undertaking in certain fields where it has already taken action. The International Civil Aviation Organization, although doubting whether an international organization for technical research in aeronautical

construction could produce effective results, believes that the establishment of an international research center for work in cartography and meteorology would be desirable. The World Health Organization, on the other hand, would reserve to itself the prerogative of selecting and directing any research on the international level in the field of medicine and public health. The United Nations Food and Agriculture Organization, moreover, does not favor the policy of developing international centers at this time, but proposes rather to encourage and support the scientific work of national institutions.

Whatever the outcome of the consideration of the important, basic question to which this report is addressed, there can be no doubt that the next steps will be taken only after the most widespread consultation with all the organizations and individuals that are competent to contribute toward the making of wise decisions. Now in the planning stage, the whole program may confidently be expected to develop along lines that are both practical in nature and idealistic in goal. Here is certainly a place where the United States may contribute leadership and demonstrate a spirit of cooperation that may bring results of truly epoch-making significance. The universal character of science may yet provide the cement to bind together the broken fragments of humanity into at least a semblance of "one world." It can do so, however, only if the intelligence of science is directed by dynamic good will.

The Chaotic University

Eric M. Rogers

Department of Physics, Princeton University, Princeton, New Jersey

SOME REFORMER once suggested that every judge should be required to spend a week in gaol, incognito. With similar intent, I would require every educator—college president, school head, commissioner, administrator of foundations—to read Aldous Huxley's *Brave New World,* as a dreadful warning, before taking office. Then, as a reward, I would let him read Sir Walter Moberly's *The Crisis in The University.*[1]

Brave New World is an entertaining book, but as a glimpse of utopia it is emetic. It paints just the future world—of gorgeously planned mechanical marvels and material comfort, soulless educational efficiency, and utter poverty of spirit—that many an educator has been thoughtlessly declaring as his aim. In contrast, *The Crisis in The University* glances back on the great past and looks at the present with dismay, but a wind of culture blows through the book and will bring refreshing thinking, (and some hopes as well as fears) to readers who have the long term good of the universities at heart. And it is the privilege of universities themselves—in England, in America, in the world—to be able to take a long term view, to remember a past that stretches back to the age of Pericles, to look forward to the future with enduring purpose.

[1] *The Crisis in the University.* Sir Walter Moberly. London: SCM Press; New York: Macmillan, 1949. 316 pp. $2.50.

The Crisis in the University is a book about British universities and their present failure, as the author sees it, to meet their responsibilities. The book is neither a wailing complaint nor an angry condemnation. It is a critical analysis of the working and aims of the universities, by one who has spent his life in British universities, studying and teaching in some, at the head of some, and now putting his own measures to trial in a college of his own founding. The book begins with a discussion of the functions and aims that have been claimed for universities by statesmen, thinkers, and scholars. There is a comparison of the two types of university nicknamed "Oxbridge" and "Redbrick." Redbrick stands for the provincial universities which have grown up in the last century, doing good teaching but offering a meager social life because they are mostly nonresidential, with students commuting daily.

Then follows a statement of present failures and a discussion of remedies. Each remedy is shown to be either spurious in itself or unworkable in modern conditions; till finally the author produces a tentative suggestion of a cure. And there he leaves the reader.[2]

Sometimes a reviewer feels he can extract the es-

[2] As my colleague Prof. F. F. Stephan put it: "In his main discussion Sir Walter acts like a receiver in bankruptcy, reporting on the universities. He asks, 'What are their liabilities? What are their assets? How can we keep the critical situation from destroying the assets in hand, and get the business of the universities back on its feet?"

sence of his author's theme and save people the trouble of reading the book itself. But this is emphatically not a book to be summed up in a few sentences such as, "The author thinks the universities are going downhill." The book is vital, solid, thorough discussion; so full of good criticism and able comment and apt quotations that I cannot justly condense it—I can only urge all who value our universities to read it for themselves. Sir Walter is diagnosing the ill health of universities of his own country.[3] I believe we in the United States are threatened with much the same ill health; but we are barely aware of the trouble because we are preoccupied with more superficial matters, such as new examinations and schemes of study, which give an appearance of sound health. But as we read Sir Walter's book, you and I will find we too have our doubts about our universities: not of their success in direct teaching and training but whether they are meeting their higher responsibilities of lasting education, of providing spiritual values and maintaining a culture which makes the ultimate difference between an educated civilization and a well-taught system of robots. Let us look at the results of our own work. If we talk with a well-trained lawyer, we are impressed by his knowledge of law and his clear grasp of our problem. We are pleased by the penetrating way in which he pins us down to clearer wording. If we talk with a successful business administrator, we are impressed by his knowledge of his business and his ease in dealing with people. If we talk with a young man just starting on a job, we are impressed by his keenness and growing interest in the special information connected with his work. If we talk with a well-settled householder, proud of his house, secure in his job, we share his genuine pleasure in a well-ordered house, his pride in efficient machines to heat the house or wash his laundry or bring him entertainment. Yet there is something missing, something apart from intellectual information and material comfort and pleasures. Where is the sense of strong guiding values, to shape a life, to command a decision? Where is the enjoyment of intellectual reflection? Where is the fiery interest in understanding which education distilled out of growing evilization and gave to a privileged few, which we now claim to offer to so many? Yes, people have these things. We meet a philosopher here in our daily life, a happy musician there, a real thinker or delighted reader in many a home. Yet these glimpses are too rare. Have our universities done all they can to foster such culture? We believe that in such intangible values may lie the greatest benefits that college years can bestow. But in voicing doubts we are not so much blaming universities for failing to do their work well as questioning their view of what their real work is. And that is always a dangerous and unwelcome kind of question.

The virtues that we miss are not the simple concrete ones like spelling or physics or even an integrated understanding of the social sciences, but intangible things, emotional, moral and spiritual, which add up to a tremendous total, the spirit of man. When we turn to the current generation of students, Sir Walter's concern will certainly touch us. Again we hesitate to embark on such criticism; but it is much easier to read about universities at a distance in another country, and see *their* aims questioned and troubles discussed. So we can start reading Sir Walter's book with a quiet heart. I do not think it will remain quiet for many pages—with Sir Walter's kindly but unrelenting help we shall soon start taking stock of our own universities.

The book starts by asking what universities should provide for the students of today (in addition to the information and direct training, which, if needed alone, could be provided better by technical schools). Sir Walter says:

> When we turn to the primary questions, concerning the things that really make or mar a university, and ask "What are universities for? What effect should they have on their alumni? What are their responsibilities to the outside world?" we are asking questions to which a minority of university teachers return discordant answers and the majority return no clear answers at all. Beneath the façade of development and hopefulness, the British universities of today share with the universities of the world a peculiar malaise and impotence. They have little inner self-confidence, because they lack, and are increasingly aware that they lack, any clear, agreed sense of direction and purpose.
>
> At this moment they cannot give an effective lead because they themselves share, and have shown small sign of transcending, the spiritual confusion of the age.

and he quotes Sir Richard Livingstone:

> What the world most needs and most lacks to-day is a clear and worthy view of life. . . . What do we do to give the undergraduate such a view? I think we must reply, "Little or nothing."

This introductory section is not so much a catalogue of woe as a gentle pointing out of those higher values which the older universities cherished, which we here envy and would cherish too if we had time to attend to them.

Sir Walter then traces the changes in university teaching and life through the following stages in the last 200 years:

[3] *The Crisis in the University* has stirred up some strong discussion in England. A critique of it in *The Cambridge Journal* for June 1949 led to a set of argumentative articles in the *Universities Quarterly*, November, 1949.

(i) The classical university, based on Christian and Graeco-Roman traditions, which he describes with loving care.

On this view the chief duty of the university is to produce good citizens. It should train an élite who are to be the future leaders in affairs and in the learned professions. . . .

Neither training in the technique of particular callings, whether ecclesiastical or secular, nor the advancement of knowledge is its primary function, though it may contribute to each. The training it gives is an initiation of select young people into their cultural inheritance. In Matthew Arnold's words it seeks to familiarize them with "the best that has been thought and said in the world" and so to bind together the generations through their sharing in a common intellectual estate. . . . In the same vein, the authors of the recent Harvard Report on *General Education in a Free Society* define "the abilities to be sought above all others in a general education," as being "to think effectively, to communicate thought, to make relevant judgments, to discriminate among values." In so doing, they echo Newman and imply that the qualities at which Oxford and Cambridge aimed in the middle of the nineteenth century are still of major importance in the middle of the twentieth.

(ii) The liberal university, with insistence on research, a diversity of studies, and a detached academic life.

(iii) The technological and democratic university, which is the present stage, and in some ways a regrettable one. It has come with the growth of science. In this last development, Sir Walter seems to feel that the American universities have led the transition sanely, whereas in England it has been hurried on by war and by changes in the social system.

Within the universities as without, these two influences, the technological and the proletarian, are in course of producing a new culture; and this differs sharply from that in which universities were nourished and took their shape. It condemns liberalism as being aristocratic and fastidious rather than equalitarian, . . . and as exalting a sterile scholarship rather than being frankly occupational and utilitarian. It regards "learning for learning's sake" as an idol to be demolished.

Sir Walter ends this section:

We have had the Classical-Christian university, which was later displaced by the Liberal university. This in turn has been undermined, but not as yet superseded, by the combined influence of democratization and technical achievement. What we have in fact to-day is the chaotic university.

In discussing the functions and aims of the universities, Sir Walter goes far beneath the surface functions and asks what part the universities have played in civilization hitherto and what they shall do in the future. Of course the answer to the second question depends on the value judgments one makes of civilization and its present trend. Some people want universities today to provide first-class technical training. Some go farther and want them to lead in planning and producing planners for a technocracy. Others look nostalgically towards the days when universities were places of quiet and culture, giving to a few the "leisure to learn to live." Sir Walter does not judge thus. He accepts some of the changes of curriculum and general life but he also looks for an element of lasting culture, of intellectual delight and spiritual salvation, which can give much needed guidance.

Finally the argument for a "cultural" education must be judged in the light of the world-crisis. In such a time first things must come first, necessities before luxuries. How this truism is applied to the university problem, will depend on how we picture the challenge of our time. If the world's troubles are due first and foremost to failure to apply systematically appropriate means to agreed ends, then what we need most is more and better experts, and the first task of education will be to produce them. On the other hand if our most intractable divisions are concerned with ends, if they arise from the difficulty which two men find in living together peaceably in a house, or two nations in a world even when food and warmth and clothing and the other necessities of life are amply provided, if the most serious menace is not scarcity but "envy, hatred and malice and all uncharitableness"; the mental commodity most in demand will be practical wisdom rather than specialized expertise. In that case the most urgent and practical service demanded of the universities will be that they should turn out an élite who will be men of judgment and "skilled considerers of human things."

As he sees the chaotic university of today, it has lost its intellectual and spiritual leadership. Its whole body, students and faculty, need a vital sense of right and clear opinion, and the lack of this has brought the universities to a crisis in which they cannot provide for the world. It is indeed a crisis if the universities have lost their leadership. Students do need help to make up their minds on major issues that confront the world. More important still, they need to realize that they must have a mind of their own on such matters. "We cannot without absurdity have an open mind about having an open mind."

The kernel of the crisis, Sir Walter believes, is neutrality of students, of faculty, of the university as a corporate whole—failure to mind about primary problems, failure to be alive to them, failure to realize which *are* the primary problems.

So far as their university studies are concerned, most students are nowhere confronted with the challenge or the opportunity to see life steadily and whole. . . . They may never come of age morally, as persons able to decide and to act as responsible human beings. In prac-

tice, of course, students must and do integrate their lives in some degree, but generally the university does not help them. In this respect it leaves them to the influence of agencies of a sub-university grade, such as the cinema and the cheap newspaper. Indeed by abstention it insinuates an impression that such integration is not a matter of the first importance. . . . The modern university is betraying its students. The more unthinking type of student simply drifts. Some sort of embryo of a working creed he must have; no one out of an asylum can live without it. But his version is uncritical and mainly unconscious, it is picked up at haphazard, and it is muddled and incoherent. He never faces as a whole the social problem or the problem of his personal life. . . . On the other hand, the thinking type of student is concerned, and often passionately, to find a working philosophy of life. He discusses major questions constantly. But since he has little help from the university, his discussion is often callow and has small reference to "the best that has been thought and known." Thus, of the these two types, the former is not being helped to ask, nor the latter to answer, the really fundamental questions; and the university is doing its duty by neither. . . .

We must remember that even for the Christian—and *a fortiori* for the modern university—the ultimate enemy, the enemy with whom there should be war to the knife, is not the ardent and conscientious atheist or totalitarian. It is the trivial-minded irresponsible thinker who does not take seriously his obligation to seek truth and to ensue it.

Having shown why he holds there is a crisis, Sir Walter discusses first palliatives, then remedies. For palliatives he pleads for such things as better residential facilities for Redbrick, and changes of curriculum to include some integrated general education courses. Considering major remedies:

(1) He rejects a return to the historical tradition of classical humanism as impossible in view of the growth of democracy and the advance of science.

(2) Nor it is practicable to return to an explicitly Christian basis—such as the old European universities once acknowledged—except for colleges with definite church affiliations.

(3) He then discusses in detail the claims of "scientific humanism" put forward by keen thinkers and enthusiastic planners. He does not seem to like this cure, although he gives science and scientists themselves full praise. I think he is arguing against a small, rather extreme group; but his refutation is still important to us as scientists. So here are the tenets he ascribes to the scientific humanists. (I have added some comments of my own in parentheses.) (a) Universities should be better organized, with less professorial wastefulness. "Capable administrators abhor waste and inefficiency and earnest reformers abhor avoidable delay," says Sir Walter with his tongue in his cheek. (Save money, economize power. But "Where shall wisdom be found, and where is the place of understanding? Man knoweth not the price thereof. . . .") (b) The universities should lessen their insistence on pure learning, much of which is antisocial, a cloak for the vested interests of the scholar. (The ivory tower may yet be a watchtower for civilization.) (c) Thoroughgoing rationalism is needed. The methods of physical science should be operated over the whole field of knowledge. (The methods of physical science are adjusted to its problems and material. It is dangerous to extrapolate them. Rash attempts to apply them to social sciences narrow the view and distort both problem and material.) (d) The universities must ally themselves actively with the forces making for social progress. (What is social progress? What is truth?)

Sir Walter considers these critical suggestions very valuable as comments with much general truth; but he disagrees with their one-sidedness. In fact their last point, (d), really gives the show away. Such critics or reformers are trying to tie the universities to a particular scheme for the advance of civilization, a scheme of planning. Should not the universities, like the King, be above political parties, even the best of political schemes?

Do we not meet scientific humanism in America, when social scientists ask for integrated courses in physical science to teach their students scientific method; or when physical scientists preach their methods as models for other fields, or even forsake their studies to set the social sciences right?

However much good there is in these suggestions for the future of the universities, there is a flavor of dogmatism, of a cult, which Sir Walter exposes.

The myth that Latin prose provides an adequate basic mental training for the engineer or the administrator is now discredited. But those who would simply, for "Latin Prose," read "the experimental method of physics" or "a training in statistics" are guilty of a similar fallacy.

He refers to a discussion between two groups:

One consisted of "scientific-humanists" who regard the world's chief need today as being further technical advance. . . . Our most urgent requirement is that these advances should go further and faster, and that hunger, cold, disease and distance should progressively be overcome. Against them others, including some scientists, contended that our primary problem is one of human relations; it is how we are going to live together in peace and amity in a world where destructive power has grown beyond all imagination. Our worst trouble is not that there is too little to go round, but that there is not a sufficiently general will that, whatever there is, should go round.

He suggests that trying their cure for the crisis in

the universities would carry our civilization still farther from the life of the spirit, perhaps nearer to a "brave new world."

What then does Sir Walter suggest as a remedy for the crisis? He has no easy cure of clear promise, but he has a suggestion. He, himself a devout Christian, suggests that small Christian groups within the great universities should make themselves felt and heard, becoming what Toynbee would term "creative minorities." He would not try to make the universities officially Christian or even to fill them with Christian teachers or students by some selection process.

> Christians should work for an "open university." This does not mean [one] which is shapeless or neutral. But it means one . . . which is hospitable. . . . No thinking will be suppressed as "dangerous." Above all there will be no "tests for teachers," no articles of faith, . . . prescribed as a condition of service.

But he would say to those who are Christians, "Speak your mind. Even in your academic work let your principles appear. Where you see right or wrong, say so. Continue a discussion into the field of religion or ethics without fear." At first this seems a rather specialized solution, but as one reads Sir Walter's good sense and moderate words one realizes that he, as a wise, believing Christian is advocating in his own terms what would apply in much the same way to groups with other beliefs. I think he would welcome the growth in the universities of other religious groups similarly intent on making their spiritual thinking and moral minding felt. So I would read his advice, perhaps without his entire agreement, as this: Let us, at the expense of some comfort and some academic progress, encourage the growth of serious thinking and ethical discussion, encourage a sense of the value of having values, by means of any groups of people, Christians and others, who will seek a clearer view and speak their minds on the ultimate problems of the day, who feel that "people matter," who would agree, perhaps, with the old saying:

"Labor, art, worship, love: these make men's lives."

The Question of Plasmagenes

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WITH THE PERSPECTIVE of a triumphant chromosome theory of heredity, E. B. Wilson (*5*) could write in 1925:

> Modern genetic experiment has given an overwhelming demonstration not only of the leading role played by the nucleus in heredity, but also of its particulate or corpuscular organization, in the sense that it is composed fundamentally of small entities ("genes," "factors," or the like) that are self-perpetuating and within certain limits independent of one another. We have very little genetic evidence in the case of the cytosome; but the fact that it is available in the nucleus predisposes us to adopt a similar conception of the cytoplasm.

The proceedings of the 1948 Paris symposium *Unités Biologiques Douées de Continuité Génétique*,[1] published not quite 25 years after Wilson's magnificent survey, are useful as a report of progress in the analysis of cytoplasmic heredity. Thanks are due the editors and organizers of the symposium for an imaginative approach. It was originally intended, apparently, to provide a coverage more closely approximating the title; but H. J. Muller, who was to have discussed the chromosomal genes, was unable to participate. The result is not, as might be thought, Hamlet without the Dane, but an attempt to ascertain the principles behind the phenomena of genetic continuity.

What are the advances in the period since Wilson's book was written? They perhaps fall into two categories, those having to do with the chemical identification of the self-perpetuating bodies, and those having to do with the refinements of technique for detecting these bodies. In the first category, combined cytochemical and genetic techniques and the identification of viruses as nucleoprotein in constitution make it seem probable that cellular structures containing nucleic acid possess genetic continuity. The advances in genetic technique, in the detection of extrachromosomal heredity, are not so much advances in principle as in application of the standard Mendelian techniques to organisms in which cellular heredity can easily be studied—the "acellular" Protozoa, and other microorganisms. The newer studies

[1] *Unités Biologiques Douées de Continuité Génétique.* Colloques Internationaux du Centre National de la Recherche Scientifique, Paris, Juin-Juillet, 1948, Vol. VIII. Paris V°: Publications du C.N.R.S., 1949. 205 pp. 1000 fr.

of biochemical systems and their genetic control enter the picture in the discussion of the role in gene action of self-perpetuating cytoplasmic elements.

With the analysis by Sonneborn of the kappa factor in *Paramecium* as a cytoplasmic element, and the discussion by Spiegelman and Lindegren of the so-called adaptive enzymes as self-perpetuating elements, the recent discussion of cytoplasmic factors in heredity may fairly be said to have begun. The data were seized upon by Darlington, and integrated with the studies of viruses in a provocative essay on "Heredity, Development and Infection." It should be kept in mind that similar approaches date back to the 1890's, when Altmann's bioblasts, and the intracellular pangenesis of De Vries were in the foreground. Indeed, the statement of Wilson regarding the chondriosome theory of Benda and Mèves is not without its contemporary applicability: "But as most leading investigators in the field have recognized, what was new was not the thing itself, or even its theoretical treatment but only an impulse to its further investigation.

Darlington's own presentation of the plasmagene theory in the present symposium lays its emphasis on the corpuscular nature of cytoplasmic heredity. The historical picture he presents is somewhat slanted: according to this, the emphasis on chromosomal heredity was owing to the isolation of European and American genetics at the time of World War I, the European workers being concerned with the cytoplasm, the Americans with the nucleus. The error in this picture is of more than casual importance. Aside from the fact that the workers on *Drosophila*, for example, were fully aware of the possibilities of cytoplasmic heredity (see the section on cytoplasmic inheritance in the first edition of the *Mechanism of Mendelian Heredity* (*2*)), a question of technique is involved. The genetic experiments which were the support of the chromosome theory of heredity were not carried out on mutants produced for the purpose. Each new mutant was an independent discovery, its analysis a research in itself. Exceptions to the standard Mendelian rules were eagerly seized upon, and their place in the scheme of things determined. The cases of maternal inheritance were recognized as important in the study of nucleocytoplasmic relations, carefully analyzed, and found to depend on specific chromosomal genes. But the fact is that in the hundreds of mutants analyzed, there has been found only one exception (discussed by L'Heritier in this symposium) to a strict chromosomal inheritance. These facts, it would seem, provide positive evidence either of a deficiency in the genetic technique, or of the relative unimportance of the cytoplasm in heredity in *Drosophila*, and indeed in most animals.

A possible defect in the genetic technique for the study of cytoplasmic heredity has indeed long been obvious. The small amount of cytoplasm carried into the egg by the sperm places the quantitative advantage with the egg cytoplasm, and only under very special assumptions concerning rates of multiplication could competing elements survive a cross in which they entered with the male parent. Such arguments were not unfamiliar during the time that Darlington supposes American genetics to have been insulated from the facts of cytoplasmic heredity (Loeb's "embryo in the rough," and the discussions of Conklin). One could conceive that selective forces in evolution had so operated that nucleus and cytoplasm were mutually conditioned—and under these circumstances experiments of a different type than the genetic would be required to determine whether the cytoplasm acted as a supply of nutrient for the nucleus, the metabolism of the whole cell then being considered as a by-product of the reproduction of the genes—or whether the cytoplasm itself contains systems of autonomously replicating units, the cell as a whole operating through the integrated action of the nuclear and cytoplasmic units. The difficulty with this type of analysis, to which attention will be paid later, is that the function of the nucleus in the developing egg becomes manifest only at the later stages of cleavage. Clearly, it is essential for the further analysis of the problem to study not the organism as a whole, but the heredity of the individual cell type.

Indeed, the studies of the heredity of microorganisms have been rewarding in just this direction. Such work is represented here by the papers of Lwoff and of Sonneborn and Beale on Protozoa; of Delbruck on the bacteriophage; of Bawden on the plant viruses; of Taylor and of Hotchkiss on the transforming agent of pneumococcus; of Ephrussi on yeast; and of Monod on the adaptive enzymes of bacteria. In the Protozoa, the transmission of the formed bodies of the cytoplasm at each cell generation is a visible evidence of cytoplasmic heredity, a fact which Lwoff traces through the complexities of its manifestation. He shows that the structures maintained owe their being essentially to two types of element, one related to the centrosomes and centromeres of the Metazoa, the other to the plastids of plants. Thus the differentiation in bands of cilia is maintained by corpuscles which are seen under the microscope to divide, to orient after division, and to take part in the formation of substances around them. Similar cases in Metazoa, it may be noted in passing, have been shown to be under nuclear control, and even, in the spectacular case of the apyrene sperm of the gastropod mulluses, have been shown by the Pollisters to involve the migration of the centromeres of the chromosomes into

the cytoplasm. One would perhaps hesitate to offer this case as a model for those who discuss gene-initiated plasmagenes, for in the apyrene sperm the centromeres do not multiply in the cytoplasm; they simply function as centrosomes, acting as synthetic centers for the formation of sperm tails. This relationship of the cilia of the Protozoa, and their formed structures in general, to the two types of autonomous element was familiar to the older workers, and may be found summarized in Wilson's book. It is a useful service to have interest in these structures revived in the modern context. Not the least remarkable fact is that the types of genetically continuous unit that are established with certainty are still only those discovered in the early explorations of biological material with the oil immersion lens of the microscope: centrioles, plastids, and chromosomes. The behavior of the mitochondrial granules is no less in doubt today than it was in Altmann's time.

The approach of Sonneborn and Beale, on the other hand, is novel. Given a specific cytoplasmic component that can be destroyed experimentally, and the means of testing its regeneration under diverse environmental and genetic conditions, it is clear that results of the highest importance for the general problem of nucleocytoplasmic relationship should be obtainable. Sonneborn has used the antigenic behavior of *Paramecium aurelia* for this purpose. In clones descended from single animals antigenic diversities are shown to be purely cytoplasmic, and transformation from one to another of the different types can be brought about by appropriate treatment with antiserum, and choice of culture condition after treatment. When, however, crosses are made with another clone, displaying a different range of antigens, the antigenic potentialities of the offspring depend upon the nucleus and thus are genically controlled. This is a situation explained by Sonneborn and Beale in terms of plasmagenes, which in this case must be conceived to be gene-initiated, since their characteristic specificities appear only in the presence of the appropriate chromosomal genes. It appears from later work that Sonneborn inclines now rather to the view that the assumption of plasmagenes is not required to explain the facts of cytoplasmic heredity in these cases, but views them rather as alternative steady states in a system of alternative pathways from common precursors. The products of reaction are mutually inhibitory of each other's formation, so that whichever is first formed persists. This possibility was pointed out by Delbruck as an alternative to the plasmagene idea during the symposium under review. The existence of such an alternative helps to dissociate two separable ideas, one the existence of competition for substrates and the like in the cell, the other the question of demonstration of the self-perpetuating units, easy when they are visible under the microscope, but quite difficult otherwise.

What are the criteria of self-perpetuation in systems where only the activity or the amount of a substance can be measured, and reproduction cannot be seen? They have been much discussed in connection with adaptive enzymes, in the present volume by Monod, and elsewhere by Spiegelman (*4*). The essential point appears to be the increase of adaptive enzyme according to an autocatalytic curve, which Spiegelman explained as due to the synthesis of replicas of the enzyme-substrate combination, for which he used the term plasmagene. Monod takes a different point of view, having based it on analyses of two systems of gene-controlled enzyme, where the enzyme activity was studied *in vitro*, demonstrated to be present in the bacteria adapted to a given substrate, and absent in the nonadapted cultures. He prefers, rather than the plasmagene speculation, to consider the kinetic possibilities inherent in the combination of gene products of low molecular weight, with protein precursors and substrate. The question may be raised as to whether this is more than a formal difference. As Monod points out, the essence of the concept of self-perpetuation is the necessity of a preexistent molecule of similar structure. Where the **S**-shaped curve can be obtained without such postulates, the plasmagene concept is unnecessary—but this does not, of course, disprove it.

The definition of the plasmagene is a loose one at present. Both Sonneborn and Darlington are inclined to call any self-perpetuating element in the cytoplasm a plasmagene, be it the kappa particle concerned with the killer phenomenon of *Paramecium*, the plastids of plants, a viruslike element such as L'Heritier's "genoid" in *Drosophila*, or what have you. For a group including the bacteriophage, cases of viruses transferred by grafting, and possibly also kappa, Darlington prefers the term "proviruses," supposed to have been derived more recently in evolution from the plasmagenes. As is not unusual with Darlington, this is perhaps more a metaphor than an analysis. As the individual cases are inspected, the discussion transforms itself in the other papers into the familiar one of the evidence for the intrinsic rather than the extrinsic origin of the viruses.

For example, Delbruck's beautiful presentation of the genetics of the bacteriophage (bacterial viruses) gives us a picture of an organism of considerable complexity, composed of a considerable number of subunits, and thus not to be thought of easily as a single protein molecule without stretching the term. The intensive genetic analysis of the phage and of

the relations with its host opened up by the studies of mixed infections (crosses), are a far cry from the generalities of Darlington's discussion. And in her studies of the lysogenic strains of *Staphylococcus,* in which the bacteriophage operates as a masked virus, Rowntree favors an extrinsic rather than an intrinsic origin of the virus. L'Heritier's paper on the virus-like body (the genoid) responsible for sensitivity to CO_2 in *Drosophila* leaves the question of origin open. But a large part of the argument for considering this body a plasmagene rests on the case of kappa in *Paramecium.* And in the case of kappa itself, the recent studies of Preer (*3*) have shown this particle to contain desoxyribonucleic acid, and have thus presented a plasmagene with the chemical composition of a nucleus, at least in part.

The problem of the chemical composition of self-perpetuating bodies has been conceived in terms of nucleoproteins since the time of Miescher, one may suppose. The recent approach stems from the studies of the chemical composition of viruses and from cytochemical studies of chromosomes, the association of the nucleic acids with biological self-reproduction having emerged from a variety of studies. The most striking demonstration is perhaps the work on the transforming agents of the bacteria, to which three papers are devoted in this symposium. Following the work of Avery, McLeod, and MacCarty, in which the transformation of polysaccharide type in pneumococcus could be induced by a desoxyribonucleic acid fraction giving no protein test, Hotchkiss has studied the amino acid composition of such fractions. He estimates that his preparations contain not more than 0.2 percent protein, and is hence inclined to look toward the nucleic acid as the bearer of specificity. Work still to be regarded as in its early stages gives indication of differences in the ratios of the purines and pyrimidines in different types of nucleic acid, thus opening an exciting prospect of studies of nucleic acid structure in relation to specificity. The contribution of Boivin, Vendrely, and Tulasne takes the same point of view, extending it to the general possibility that the ribonucleic acids of the cytoplasm may also be the determiners of the specificity of the proteins. This is perhaps the trumpet call of a revolution in thought about the chemical basis of biological specificity; even if it should turn out to be only the flourish of a minor engagement, the present possibilities are too intriguing to be disregarded. Especially is this emphasized by Taylor's finding that the pneumococcus preparation itself has at least two components, each responsible for a specific transformation.

The pneumococcal nucleic acid is of the desoxyribose type, like that of the nuclei. The plant viruses, on the other hand, contain only ribosenucleic acid, like the plant plastids. In these cases, the specificity has been thought of largely in terms of the proteins, due chiefly to the differences found by Stanley and Knight, and more recently by Knight (*1*) in the amino acid content of some strains of virus. Bawden is critical of these views in his discussion, coming to the conclusion that at the present time the relation between the composition of the viruses and their specific effects upon their hosts remains obscure, and that these differences may just as well be correlated with the nucleic acid as with the protein moiety of the virus.

With the view that the nucleic acids can be regarded as associated with processes of synthesis and self-perpetuation, it has been tempting to consider the nucleic acid-containing granules of the cytoplasm as self-perpetuating—a view emphasized by Claude. This view derives its support from an analogy with the behavior of the plant plastids. Thanks to the analysis presented by Rhoades, these also give one type of model of the interaction of nuclear and cytoplasmic units. Rhoades was able to show that a specific type of chlorophyll variegation in maize, inherited as a recessive gene, actually is due to mutations induced in the plastids under the influence of the specific genotype. A case in yeast, reported by Ephrussi, of a mutation in colony type induced by acriflavine treatment, possibly also involves a plastid-like body, containing the cytochrome oxidase system. Here there is no relation as yet found to the nuclear genes. In both cases the cytoplasmic units can be considered as symbionts. But the fact that gives pause is that both (assuming the yeast unit to contain nucleic acid) do contain the nucleic acid commonly associated with the cytoplasm in animals. Accordingly, the treatment of the problem of plasmagenes in animal development, by Brachet, is most welcome, filling a needed place in the symposium. Oddly enough, his examination of the embryological facts in animals is more to the point of the symposium than the two papers on plant development by Camus and by Gautheret. These studies, interesting aspects of the relations of the auxins to morphogenesis and tumor formation in plants, present material still to be analyzed from the point of view of the units in nucleus or cytoplasm responsible for the changes.

Brachet faces the issue squarely, considering the types of evidence needed to show that there are in the cytoplasm self-perpetuating particles whose varied distribution in the cells of the organism is responsible for its differentiation. From the combination of genetic and cytochemical experiments with those of experimental embryology that is possible in his amphibian material, he reaches the conclusion that at the present no evidence exists for the autono-

mous determination without nuclear participation of the specificities of cytoplasmic particles. Following a hypothesis by T. H. Morgan, he finds the most attractive speculation on the nature of differentiation in a sequence of changes induced reciprocally on each other by nucleus and cytoplasm—a point of view the present writer has also taken.

All in all, one is left with the feeling that the concept of gene-initiated plasmagenes has received no support in this volume, especially in the light of Sonneborn's more recent work. But the importance of this type of work for the understanding of cellular heredity cannot be overestimated. The plasmagenes are only one hypothesis; it is from the experimental material that new ones are born. The plasmagene hypothesis itself, aside from Spiegelman and Monod's kinetic considerations, was essentially the full recognition that a hierarchy of hereditary units may exist, in which the genes take precedence. The nomenclature is unfortunate; as said before, the most diverse types of material have been called plasmagenes. That this should occur at a time when the approach is being made to a definition of the gene in terms of a single function per gene has not conduced to clarity in thought. Defining the term *plasmagene* in one paper as an incomplete gene replica, and in another as an independent symbiont is not helpful.

One aspect of the results that may be stressed is the substantial importance of symbiosis in biological systems. We have become increasingly aware of the important role of the intestinal flora of such organisms as the mammals. In the context of this symposium, the problem of symbiosis appears on an intracellular basis, where the statistical considerations of the competitions between types are difficult to distinguish from those involved in such systems of chemical reactions as that postulated by Delbruck as an alternative to plasmagenes. Indeed, if plasmagenes existed, they might very well behave according to Delbruck's "alternative." It is necessary to develop concepts of the kinetics of self-perpetuation which might permit a testable differentiation.

It is evident, with this resumé, that the only definite cases of self-perpetuating elements in the cytoplasm that require the presence of identical preexisting elements for their formation, and that perpetuate specific changes in their own structure (mutants), are plastids, viruses, and the "central apparatus" in plants and animals. The existence of subsidiary levels of self-perpetuation remains in the questionable state it occupied in Wilson's time. Such phenomena are by no means excluded, but ways of testing for them have still to be devised—methods that will directly attack the function of the nucleus and its relation to the growth of cytoplasmic units.

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The Committee on Foreign Compendia

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THE COMMITTEE OF American Chemists which eventually became the Committee on Foreign Compendia of the American Chemical Society had its beginning when Aristid V. Grosse, then with the Houdry Corporation, proposed the idea to me on Thanksgiving Day in 1945. Dr. Grosse offered to take on the burden of being secretary if I would serve as chairman. We held these offices until January, 1950, when Dr. Grosse was prevailed upon to accept the chairmanship. At present the other members of the committee are: Roger Adams, Marston T. Bogert, W. Conrad Fernelius, Henry Gilman, Ernest H. Huntress, C. S. Marvel, Linus C. Pauling, Glenn T. Seaborg, and Floyd T. Tyson.

The purpose of the committee is to follow the situation with respect to the two most important encyclopedias of chemistry: Beilstein's *Handbuch der organischen Chemie,* and Gmelin's *Handbuch der anorganischen Chemie.* It was fairly obvious that the devastation of World War II must have interfered seriously with the functioning of these two organizations. A poll of practicing chemists disclosed no one who felt that these great handbooks were dispensable. The important questions were: Could the compendia be saved? What could we do to help?

It was soon discovered that very little foreign literature had been available to either Beilstein or Gmelin from 1940 on, and lists were secured from Drs. Richter and Pietsch of the books and journals which were indispensable to the task of summarizing the world's research in organic and inorganic chemistry. Appeals were then made to American chemists who had such journals and were willing to sacrifice them for the common good. The result was a heartwarming evidence of the generosity of American chemists and of the truly international nature of science. Most of the requested publications were promptly supplied. The American Chemical Society appropriated funds to cover the cost of transshipment.

Almost at once the problem of duplicate sets of journals arose. It was decided after consultation with the editors that these also would be forwarded, to be used toward the restoration of bombed-out libraries or in trading for missing journals.

Many authors or publishers of desired books contributed copies. The American Chemical Society donated copies of its journals. In short, the problem of literature has been solved fairly completely.

This proved insufficient. Word reached us that such ordinary commodities as incandescent bulbs were in short supply. Dr. Tyson found that they could legally be inserted in CARE packages in adequate numbers. Food was short in Germany, and was supplied through the generosity of American chemists.

Beilstein rather promptly published Vols. VI to X of the second supplement to the fourth edition and found that American sales had doubled as a result of World War II. During the war Edwards Bros. of Ann Arbor, Michigan had sold a cut-rate edition of Beilstein as a substantial aid to American chemistry. Because they had to bear no part of the editorial expense the cost was low enough to permit many libraries to purchase Beilstein's for the first time. Naturally, these libraries now wish to keep these compendia up to date. At present, Beilstein is operating on a balanced budget and, while far from prosperous by American standards, seems to be keeping its head above water and swimming vigorously.

The situation with Gmelin has been more difficult. This is due in part to the relatively smaller emphasis now being put on inorganic as against organic chemistry. In part it is due to the greater antiquity of inorganic chemistry and the basic Gmelin principle of critical evaluation and complete coverage of all material in the field published since 1750. In view of the tremendous increase in the number of papers published in recent years, it has become increasingly difficult to treat the entire material in all details. As a result, it will be necessary in forthcoming issues of the *Handbuch* to place greater emphasis upon recent developments at the expense of earlier information, to summarize related subjects more briefly, and to speed up publication. The publication program for the fiscal year 1949–50 comprises approximately 1,920 pages of new Gmelin issues. The first postwar publication in the inorganic series (System No. 10-B, Selenium) reached this country in the summer of 1949. The translation, with annotations, of Libavius' *Alchemia,* the first chemical compendium, dating back to the year 1597, was also completed last year and is awaiting a publisher.

The American Chemical Society, led by Roger Adams, then chairman of the Board of Directors, solicited the chemical industry of this country for help for Gmelin and sent $30,000 last year. An equal amount is expected to be donated by German industry. These donations have so far kept the Gmelin Institute functioning; the future is still obscure.

Under present conditions of international tension, it is no comfort to the Gmelin workers to realize that their location at Clausthal-Zellerfeld is only six miles from the boundary of Russian-occupied Germany.

The precarious position of the Gmelin Institute points up what is one of the most serious of the problems confronting modern science. Every year our universities turn out more researchers. Every year industry, governments, research institutes, and the academic world produce more and more research results. The editorial offices of our principal journals are clogged with worthy articles which should be published. Even with highly condensed presentation and the increased numbers of pages provided in the journals, the flood of research results is all but overwhelming. Yet for maximum utility this great volume of research must not only be published, but must be coordinated, correlated, systematized, and made available. The organized scientists of the world are simply not devoting sufficient effort to the task. Research is so fascinating as compared to the drudgery of compiling and coordinating!

As a result, the library of each important chemical company repeats in part the work which would need to be done only once if it were done promptly and thoroughly. Here is a task worthy of the attention of every important organization of scientists.

Book Reviews

Albert Einstein: Philosopher-Scientist. Paul Arthur Schilpp, Ed. Evanston, Ill.: Library of Living Philosophers, 1949. 781 pp. $8.50.

The editor, P. A. Schilpp, is to be congratulated on the production of this most important and significant volume. It is most difficult to get scientists to write simply and clearly about the fundamentals of their science and the leading philosophical ideas which guide them. Yet these very attitudes, preferences, and tastes are the fundamental ingredients which give quality, differentiation, and individuality to scientific creation and discovery. This aspect of scientific life and thought rarely appear in formal courses or in the foreground of scientific papers. The wellsprings of intellectual motivation and scientific creation are usually kept in the background and the final results are presented in as elegant, formal, and dehumanized a manner as is possible to the writer. This is as it should be, for science is poetry only in a broader sense and the results of science should be independent of the philosophical position of the scientist. In the last analysis, success in the prediction of the results of experiment is the only acceptable validation of a scientific theory. Likewise, the importance of a scientific result can be judged only by its implications for wider scientific understanding of natural phenomona.

Nevertheless, the great structure of science is made by human beings in all their varieties, adventurous and cautious, intuitive and coldly logical, the searcher after new and strange phenomona, the conservative builder of a sound, rigid, structure out of the known, but not completely comprehended. All these people with their different temperaments and tastes together have erected the formidable body of knowledge which is physics.

In this book there is played out a great scientific drama of the last two decades. The central theme is not a matter which is strictly scientific. It is not whether quantum mechanics is correct in the sense that it gives a true or false description of physical phenomona. It is agreed that quantum mechanics has been extraordinarily fertile in predicting new phenomona which have been verified by experiment and that it has reconciled a whole host of seemingly contradictory experimental results.

The sole question is whether quantum mechanics is satisfactory from the philosophic and aesthetic point of view, and whether it is a good point of departure for a more profound understanding of physical phenomona.

The book starts with an intellectual autobiography by Einstein himself. He satirically calls it his obituary. It is a singularly moving and charming document. I know of no other to compare with it. Neither Newton nor Maxwell nor any of the great giants of physics had his Schilpp to catalyze such an effort. After reading Einstein's article one realizes the great loss this is to scientific culture.

Einstein traces the development of his scientific attitudes frankly and objectively, with many amusing digressions on education and other topics. He describes the crosscurrents of the scientific thinking of his day and the points of departure from which he made his great early contributions to statistics, quantum theory, and relativity. It is an entrancing story. At the end it becomes manifest that relativity and field theory are his great loves. In these fields and modes of thought he finds real joy and comfort of spirit. Quantum theory, which has so completely pervaded the thinking of this age, leaves him quite cold. To him it is a provisional and useful structure but only, so to speak, "what to do till the doctor comes." Yet, as becomes clear in later articles—particularly those of Bohr, Born, and Pauli—Einstein, almost more than anyone else after Planck, formulated the leading ideas on which quantum mechanics is founded. From a reading of Einstein's article, one has the impression that he never permitted himself to grasp the importance and significance of his own tremendous contributions to quantum theory.

For all the revolution which he brought to modern physics, Einstein remains the great classicist. Statistics for him are a means of gaining knowledge in situations where one is of necessity ignorant of the precise values and properties of many of the variables. However, to introduce a statistical interpretation into the very fundamental relations of physics, into the simplest conceivable physical situations, is repugnant to him. It is best summed up in his statement that he is willing to believe that the dear God plays dice, but not according to fixed rules.

With this attitude, Einstein has withdrawn himself from the mainstreams of physics of the last two decades. He has devoted himself to what he believes will be the right path to the construction of a unified field theory, which will combine the gravitational and electromagnetic properties of matter. Such a program, if successful, would leave no room for such empirical constants as the electronic charge or mass or Planck's constant; the charge quantization as well as energy quantization would come out directly as a consequence of the theory. It is a bold program, for which Einstein has found only a few followers.

Of the three founding fathers of quantum theory, Planck, Einstein, and Bohr, Bohr remains as the leading protagonist and the acknowledged leader in this subtle discipline. He is also the great repository of quantum mechanical wisdom. His contribution to the book is a history of his discussions with Einstein on the fundamentals of quantum theory. With infinite charm and tact, he describes Einstein's profound criticisms of various aspects of quantum theory. The ingenious and subtle ways by which these objections have been answered are fully given by Bohr. Those who have been privileged to hear Bohr speak of these matters will renew their

pleasure by reading these beautiful analyses of elementary but tantalizing paradoxes. Here also Bohr describes his principle of complementarity, which is his great tool for reconciling the apparent contradictions in quantum phenomona, and beyond that the basis for his whole philosophic position not only for science but more universally.

There is not enough space to discuss or even to mention the many wonderful papers in this volume or the rebuttals which Einstein gives to his critics in the last article. The careful reader will find this book an inexhaustible mine of insight and knowledge in the development of the scientific thought of our century.

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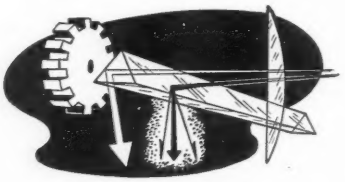

Reports on Progress in Physics. Vol. XII, 1948–49. London, S.W.1, England: The Physical Society, 1949. 382 pp. 2£ 2s. net.

This is the 12th volume of the admirable series of grouped surveys of topics in physics and the related sciences, which the Physical Society of London has been presenting to the world of physicists over a period of years. As contrasted with the nearest American approach to an equivalent—our *Reviews of Modern Physics*—the surveys of these volumes have often been better suited to the needs and powers of the nonspecialist, and many of them are actually readable. This volume is no exception to the rule; but since it is impossible to write 14 adequate reviews of as many articles on as many subjects, the reviewer can add little but names and titles to the foregoing words of general praise.

H. G. Thode and R. B. Shields deal with mass spectrometry, carefully defined as "instruments for ion collection and measurement in connection with relative-abundance determinations," and excluding the precise measurement of masses. B. V. Rollin treats briefly, under the title "Nuclear Paramagnetism," of what is more commonly called nuclear magnetic resonance. The essay of G. F. J. Garlick, "Phosphors and Phosphorescence," is "restricted to a survey of investigations of impurity-activated phosphors of crystalline structures which are synthesized by heat-treatment of their basic constituents." An article by D. K. C. MacDonald covers broadly and ably the field which he calls "spontaneous fluctuations," more commonly known perhaps as "noise." Transmutation, pair-production and other effects of the very short wave x-rays now available from accelerators are reviewed by W. Bosley and J. D. Craggs; and linear accelerators themselves by D. W. Fry and W. Walkinshaw of T. R. E., whose account will be read with especial interest by the constructors of high voltage research equipment in this country. G. O. Jones takes us abruptly to the other extreme of physics with a paper on "Viscosity and Related Properties in Glass," and N. Cabrera and N. F. Mott go clear over the border into chemistry with "Theory of the Oxidation of Metals."

We get back into solid-state physics in the second longest article of the book, that of E. Orowan, "Fracture and Strength of Solids," and then find ourselves among the gases and in the field of spectroscopy when we confront the "report" by A. Rubinowicz of which the purpose is "to summarize the more important of the recent advances in the field of atomic electromagnetic multipole radiation," and also the following essay by H. S. W. Massey, "Collisions between Atoms and Molecules at Ordinary Temperatures." K. Mendelssohn writes under the title "Low Temperature Physics," but confines himself to "recent advances in technique, supereonductivity and superfluidity." M. Ross and J. S. Story provide us with a tabulation of slow neutron absorption cross-sections of the elements. Much the longest paper of the book is the last, the highly mathematical essay of J. de Boer entitled "Molecular Distribution and Equation of State of Gases." The reviewer envies anyone who can read all of these articles, good as they are.

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Fluorescence and Phosphorescence. Peter Pringsheim. New York-London: Interscience, 1949. 794 pp. $15.00.

An Introduction to Luminescence of Solids. Humboldt W. Leverenz. London: Chapman & Hall; New York: John Wiley, 1950. 569 pp. $12.00.

The science of luminescence is barely 100 years old (Sir George Stokes, 1852), but observations regarding luminescent materials are hundreds of years old. However, the understanding of the process of luminescence as contrasted to the emission of light due to temperature has been cleared up only within the last 30 years, after the successful interpretation of such observations on the basis of quantum theory. The first systematic attempt was Pringsheim's book, *Fluorescence and Phosphorescence in the Light of the New Atomic Theory*, 1921. This slender volume of about 200 pages, with some 260 references, is now expanded into the present imposing treatise containing a review of over 2,000 references (up to May, 1948).

In temperature radiation, the energy of radiation is due to the average energy content of the molecules as determined by temperature; whereas in the process of luminescence a molecule may receive an excitation energy exceeding the average temperature energy. This excitation energy is then emitted as luminescent radiation.

For luminescence it is therefore necessary that processes of excitation take place and that the energy taken up by atoms, molecules, or more complex systems be stored until it is emitted again as radiation. In rarefied gases, where the number of collisions is small, and in certain

organic and inorganic compounds containing a small number of active centers, these conditions are fulfilled.

Since gases, under proper excitation conditions, can always be made to luminesce, Pringsheim starts his discussion quite logically with the fluorescence of gases and vapors. After sketching the postulates of the quantum theory, energy levels and effects of perturbation are discussed. A brief discussion of the duration of luminescence processes leads to the definition of phosphorescence and fluorescence. Some time ago Pringsheim (following Perrin) pointed out that one has to define much more sharply the actual production of light which is due to transitions which may be determined (1), in fluorescence,

> . . . only by the inner (atomic, molecular, or also lattice dependent) transition probabilities, while (2) in phosphorescence there is always a metastable state involved in the mechanism, as a result of which the process of emission is essentially temperature dependent.

(Pringsheim, Faraday Society discussion, 1938).

Pringsheim deals first with monatomic gases and vapors, introducing the nomenclature and theory of spectra, discussing fluorescence lines and their various types of excitation, the absorption and emission process, and the interesting polarization phenomena of resonance radiation in a magnetic field. After a discussion of the perturbation of resonance radiation by collisions, the author treats sensitized fluorescence, which is of great importance in the understanding of the fundamental process of fluorescence. This chapter is followed by a discussion of fluorescence in diatomic and polyatomic gases and vapors. In all these cases the underlying basic theory is first introduced and then applied to the actual process of fluorescence in gases. In this way a solid theoretical foundation is laid for a logical understanding of the physical processes.

After these 280 pages devoted to gases, the fluorescence and phosphorescence of condensed systems are considered. A general survey of the nature of luminescent substances, the course of emission processes, and the yield is followed by a discussion of the polarization and angular intensity distribution of fluorescence radiation. There is a chapter on the fluorescence of organic compounds—a field recently made interesting by the discovery of the importance of these substances for scintillation counters. The luminescence of pure inorganic compounds is then studied and finally in some 150 pages crystal phosphors are dealt with.

Throughout the whole book by Pringsheim there is a good balance between the treatment of experimental results and their theoretical interpretation. Not since 1908, when Kayser summarized the empirical material of his time in the *Handbook of Spectroscopy* has such an encyclopedic task been attempted and successfully completed.

In a similar encyclopedic way the luminescence of solids has been treated by H. W. Leverenz, using well over 1,000 references dealing with this field of luminescence. Leverenz's book addresses itself to a somewhat different type of audience. It does not assume that many of the theoretical concepts of modern physics are known, and therefore the first 130 pages contain an introduction to some basic ideas of modern physics as applied to solid state problems. Elementary particles, kinetic theory, crystal symmetry, the difference between ideal and real crystals, and crystal growth are discussed. The section on the synthesis of luminescent solids, "phosphors," first introduces the concepts that are necessary to understand the problem from the point of view of analytical and physical chemistry. Then it outlines the synthesis and naming of phosphors and the possibility of designing a phosphor for a particular purpose. A table gives examples of initial ingredients, conditions of preparation, symbolism, and some properties of representative phosphors. This will be of great value to anybody who is interested in the preparation of these materials. There follows a discussion of energy states as applied to the problems of phosphors. The questions of energy transport and photoconduction, and the generalized energy level diagrams of phosphor centers are treated. After this preparation the luminescence of phosphors is covered in great detail.

Leverenz prefers the customary definition of fluorescence and phosphorescence, according to which phosphorescence is a long-time afterglow, whereas fluorescence stops at the end of the excitation. A discussion of the excitation process (with some useful figures on energy losses by radiation as well as by charged particles in passing through solid matter) leads to the questions of excitation spectra, energy transfer and storage, and treatment of electron traps and the trapping process in phosphors. This is followed by a discussion of emission spectra vs. temperature spectra, and finally by a discussion of emission spectra in a number of representative phosphors, both natural and synthetic.

In the phosphors themselves there is a correlation between the host crystal—or, as some investigators have called it, the basic lattice—and the phosphor properties as determined by the activators. The discussion dealing with these problems is perhaps the most important chapter because of the many problems still facing both the theorist and the experimenter.

The book closes with a chapter on the uses of phosphors. Leverenz describes applications of cathodoluminescence to cathode ray tubes in television, radar kinescopes, image tubes, and electron microscopes, as well as the use of ultraviolet-induced luminescence in fluorescent lamps, and the uses of x-ray luminescence.

In the end there is a brief reference to phosphors as particle and radiation detectors. The appendix contains some brief references to the preparation of certain pure phosphors, a summary of general spectral characteristics of luminescence, and a table giving a summary of some magnitudes and structures involved in the luminescence of solids. Besides a name and subject index there is a formula index for the most common phosphors. Leverenz has added a special representation of the periodic system which contains useful information usually omitted in other such representations.

Each book constitutes as nearly complete a summary of our knowledge of luminescence as might be given at

the present time. The rapid development in this field becomes clear if one considers the literature references and their growth in the time elapsed between the completion of the two manuscripts and their publication. For future editions we wish to point out that in works of such magnitude all references in the text to tables, figures, or formulas should always be accompanied by the page reference, or else the chapter number should be put at the top of each page; as it is, one has to spend a long time finding any reference.

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Atomic Age. (Sir Halley Stewart Lectures, 1948.) M. L. Oliphant *et al.* New York: Macmillan; London: Allen and Unwin, 1949. 149 pp. $2.50.

Atomic Energy Yearbook. John Tutin, Ed. New York: Prentice-Hall, 1949. 237 pp. $3.85.

Constructive Uses of Atomic Energy. S. C. Rothmann, Ed. New York: Harper, 1949. 258 pp. $3.00.

These recent additions to the current vogue for books about atomic energy are concerned with three different phases of the subject. The Sir Halley Stewart Lectures for 1948 are reproduced in *Atomic Age.* It presents the views of the authors on the military, economic, moral, and political aspects of atomic energy. Since each of the articles epitomizes the philosophy of a different specialist, the opinions and conclusions are divergent and stimulating. The chapter by P. M. S. Blackett is a concise presentation of his widely discussed evaluation of the military consequences of atomic bombing. This is followed by a protest against this assessment, ably presented by R. F. Harrod in the chapter on "Economic Consequences of Atomic Energy." Harrod also takes issue with optimistic predictions of the blessings of atomic power. He analyzes the various ways in which the new source of energy could influence world economy and concludes that he "is skeptical about the alleged economic benefits to humanity, anyhow in this generation."

Chapters by Bertrand Russell and Lionel Curtis deal with the moral and political necessity for some kind of world government. Although they are not in agreement on all phases, both present pithy and compelling arguments for an immediate if limited union of Western democracies. Their statements on the ultimate responsibilities of the United States in the atomic age, and the article "America as Atlas" by D. W. Brogan deserve serious consideration by all responsible American citizens.

In contrast to this book, which should be of interest to all readers, the other volumes will appeal to more limited interests. The *Atomic Energy Yearbook* is an excellent summary of current nonmilitary work in atomic energy. In it are listed the development and research establishments in all countries from which the information is obtainable. Detailed and factual accounts are presented of the kinds of work in progress at these various laboratories, the available facilities, the status of the programs, and probable trends for the immediate future. The book will be most valuable to workers who are interested in a broad survey of all activities in this field.

On the other hand, the articles in *Constructive Uses of Atomic Energy* are preponderantly speculative. The reader expecting detailed information or statements of actual accomplishments will be disappointed. The book consists of a collection of 14 short essays based on articles which originally appeared in a variety of technical and trade journals such as *Electronics, Iron Age, Machine Design, Chemical Engineering,* and *Occupational Medicine.* It is intended primarily for the casual reader who is interested in general predictions of the potential nonmilitary applications of atomic energy covering such subjects as atomic energy as a human asset, atomic energy in industry and the physical sciences, atomic power for industry and aircraft, radioactive isotopes for research, medical and industrial uses. Two of the appendices are very useful contributions; one is an excellent glossary of scientific terms used in most popular and scientific literature on atomic energy, the other is a valuable and extensive bibliography which will be of interest also to workers in the field.

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An Introduction to Molecular Spectra. Raynor C. Johnson. New York: Pitman Publ., 1949. 296 pp. $7.50.

This concise introductory text on molecular spectra provides, considering its brevity, a reasonably complete summary of the major features of molecular spectra. In its general level and approach it can, perhaps, serve as a companion volume to the well-known text by White on atomic spectra. It may thus occupy a place as yet unfilled by any generally accepted book on this subject. The nearest existing approximation to such a standard text is probably the first volume of the incomplete Herzberg trilogy, which treats only of diatomic molecules. The present book covers a wider field, necessarily less completely.

No knowledge of group theory or of quantum mechanics is assumed on the part of the student. This approach has, of course, both advantages and disadvantages, but seems a wise choice for a text treating so large a subject within so narrow a compass.

It will rightly be inferred, from what has been said, that the specialist will not find very much that is new or stimulating in the book. Except insofar as he is a teacher, the inference is correct. An idea of the condensation attained may be gotten from the titles and length of some of the 15 chapters. These include, for example, Electronic States of Molecules (16 pages), Rotational Terms and Vector Couplings (10 pages), Spectra of Polyatomic Molecules (53 pages). The Zeeman effect rates 17 pages; the Stark effect is not mentioned. The references are adequate, but barely so. The index is a mere three and one-half pages.

The student completing the text will have had a good once-over-lightly introduction to the subject; the text is solid enough but there is much that is not included. Whether one calls this omission of unnecessary detail or lack of thoroughness depends on the viewpoint; this reviewer, considering the probable use of the text, leans

toward the former. Incidentally, the book is dated 1949, but the author's preface is dated December 1945. This doubtless explains why microwave molecular spectroscopy goes unmentioned, since this is almost entirely a postwar development. One can only regret this, since a fairly large fraction of students now interested in molecular spectroscopy are concerned with this new branch of the field.

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Practical Spectroscopy. C. Candler. London N.W.1: Hilger & Watts, 1949. U. S. distributor: Jarrell Ash Co., Boston, Mass. 190 pp. $6.10 postpaid.

This book is one of the well-known Hilger publications dealing with selected topics of applied optics and allied fields. Although it has been written primarily for university and technical college students, it is a source of valuable information for everyone interested in the field of practical spectroscopy. The book contains elementary treatments of spectroscopic instruments and auxiliary apparatus, including photometers and interferometers. The various methods of wavelength measurements, qualitative and quantitative spectrochemical analysis, and absorption spectroscopy are discussed in some detail. About one-fifth of the book deals with infrared spectroscopy.

The book's most remarkable feature is the abundance of experiments and practical exercises described at the end of appropriate chapter sections. Every instructor of a laboratory course in practical spectroscopy will greatly profit by this collection, even though he does not have all the instruments. The text refers mainly to instruments made by Hilger, but this does not impair its general value, since most of the experiments can be performed with other apparatus also.

K. W. MEISSNER

Purdue University

Introduction to Theoretical Physics, 5 vols. Max Planck. Reissue; translated by Henry L. Brose. ***General Mechanics,*** Vol. I, 272 pp. ***The Mechanics of Deformable Bodies,*** Vol. II, 234 pp. ***Theory of Electricity and Magnetism,*** Vol. III, 247 pp. ***Theory of Light,*** Vol. IV, 216 pp. ***Theory of Heat,*** Vol. V, 301 pp. New York: Macmillan, 1949. $3.00 a volume.

This work consists of five volumes of modest size, written between 1916 and 1932. The first volume deals with the general mechanics of mass points and rigid bodies, and the second with the mechanics of deformable bodies—elasticity, sound, and hydrodynamics. Volume III, on the theory of electricity and magnetism, covers static and dynamic processes in vacuum and in continuous media, and in conclusion points out the conceptual need for Einstein's restricted principle of relativity. Volume IV, on the theory of light, treats geometrical and physical optics, crystal optics, and dispersion, and finally draws an analogy between the optics of inhomogeneous bodies and the Schrödinger equation of quantum mechanics. Volume V deals with the theory of heat—thermodynamics, heat conduction, thermal radiation, and statistical mechanics. It was the unifying role of the last-named subject, in basing the concepts of heat on mechanics and electrodynamics, that led the author to place this volume at the end of the series.

The approach throughout stresses clarity of physical concepts rather than mathematical elegance or comprehensive coverage. The result is a work that goes much farther beneath the surface than the usual elementary physics text, and is not as detailed as the advanced specialized books on the separate fields of physics. Knowledge of analytic geometry and differential calculus is assumed in the first volume, and of integral calculus and some differential equations in the others. These volumes appear to be most suitable for use by exceptionally capable elementary physics sections, for separate courses at the intermediate level, and for reference or review by advanced students of physics.

L. I. SCHIFF

Stanford University

University Physics. Francis Weston Sears and Mark W. Zemansky. Cambridge, Mass.: Addison-Wesley, 1949. 848 pp. $6.00.

This textbook, based on the senior author's Principles of Physics series, is intended to cover a one-year elementary course for physics and engineering students taking concurrent courses in calculus.

The chapters on mechanics and hydraulics, which occupy almost one third of the book, are excellent. The treatment is, above all, rigorous. Vector analysis is used throughout. Calculus is introduced gradually. Typical of this section of the text is the treatment of Newton's second law, which is first introduced in its simpler form, but later reformulated in the more rigorous form used in mathematical physics. Three systems of units—English gravitational, mks, and cgs—are introduced, but mechanics are discussed largely in the first system.

Electricity and magnetism are covered in another third of the book and given much the same rigorous treatment as mechanics. The rationalized mks units, which simplify the writing of Maxwell's equations, are used, but the authors neither develop nor state Maxwell's equations.

The remaining third of the book deals with the subjects of optics, heat, sound, and atomic physics. The mathematical treatment of optics is comprehensive. The other chapters are generally more qualitative or descriptive in form and contain some equations whose derivations are not given, but whose meaning the student can grasp. Introductory equations and definitions, however, are treated rigorously: thus the short section on heat contains a thorough discussion of temperature scales. Thermodynamics is treated without either the concept or the term of entropy. In the final chapters the student is whisked from the Bohr atom to nuclear reactors and brought as close as possible to the present frontier of physics.

Students of engineering should find this text clear and practical and derive much aid from the many problems and examples. Physics majors should receive a sound introduction from the rigorous treatment of the more

comprehensively covered fields, but may wish additional information on thermodynamics and sound.

T. ENNS

Johns Hopkins University

Some Recent Researches in Solar Physics. F. Hoyle. London-New York: Cambridge Univ. Press, 1949. 134 pp. $3.00.

This book in the new series of Cambridge Monographs on Physics deals mainly with Hoyle's own recent work on the corona and chromosphere, carried out in collaboration with Bondi and Lyttleton. It is therefore mainly of interest to workers in this branch of astrophysics.

The monograph starts out with two chapters dealing with sunspots and with the observational data regarding the chromosphere and the corona. The final chapters deal with electromagnetism in solar physics, terrestrial phenomena directly influenced by the sun, and emission of radiowaves by the sun.

The book's main merit probably lies in the fact that it will draw attention to the importance of accretion processes in astrophysics. It seems to me that Hoyle's conclusions are far from final. His considerations fail, for instance, to account for the fact that only a certain select group of spectra are emitted by the corona, whereas other spectra corresponding to ionization potentials and excitation energies of the same order of magnitude as those of the observed spectra are not present.

The theoretical part appears to give a quantitative discussion, although it is noted by Hoyle that the results indicate only orders of magnitude. A more qualitative discussion might therefore have been more to the point. Also Alfvén's influence on ideas about electromagnetic effects in astrophysics might have been stressed more.

D. TER HAAR

Purdue University

Introduction to Theoretical and Experimental Optics. Joseph Valasek. New York: John Wiley; London: Chapman & Hall, 1949. 454 pp. $6.50.

This book is an introduction to the various fields of advanced optics, both theoretical and practical. To read it with real understanding requires more than a passing acquaintance with optics and theoretical physics. The theoretical material is well presented. Each discussion is necessarily very condensed, however, because the author touches upon so many topics. The good student will be stimulated by these brief presentations of material new to him and will complement them by reference texts, many of which are named in the good bibliography included here.

It is pleasing to see many engineering optical applications included and brought into close connection with theoretical optics. This is accomplished in part by the 24 optical experiments described at the end of the book, each requiring reference to a portion of the text. There are also included throughout the text optical applications in engineering and in other fields of service. For example, there is a good treatment of the one subject in optics of most importance to all of us—the eye and spectacle lenses. One searches in vain, however, for those recent applications of physical optics, reflection reducing films, and interference filters.

It is suspected that the author, in common with the reviewer, accepts with hesitation the recently recommended photometric terms *illuminance* and *luminance*. Though *illuminance* is used everywhere in place of the older term *illumination*, the section that discusses *luminance* is entitled, "Brightness of Images." It remains to be seen whether the younger generation will find the new words less confusing than the old.

This book is also useful as a handy reference text for the specialized optical worker who wishes to refresh himself quickly on some matter in another field.

RICHARD TOUSEY

Naval Research Laboratory

Partial Differential Equations in Physics. Arnold Sommerfeld; translated by Ernest G. Straus. New York: Academic Press, 1949. 335 pp. $5.80.

The present book is a translation of the sixth volume of Sommerfeld's *Lectures on Theoretical Physics*. The theory of partial differential equations is, of course, not a branch of theoretical physics. Its inclusion in Sommerfeld's series of lectures is, however, well justified, not only because of the author's many valuable contributions to this field, but because this branch of mathematics, above all others, is an indispensable tool in the theoretical physicist's work.

The motivation for the selection of topics and for the procedures employed is physical throughout this volume, and in this respect the book differs considerably from most modern writings on its subject. It is closer in spirit to the classical literature in this field, whose authors still believed in the "preestablished harmony" between what is physically important and mathematically significant. The book starts with an introduction to Fourier series, Fourier integrals, and other Fourier-like expansions, and then proceeds with a discussion of the various types of partial differential equations and boundary conditions arising from physical problems, and of some basic tools used in solving them. The next chapter deals more specifically with boundary value problems in heat conduction. This is followed by a rather detailed but concise treatment of cylinder and sphere problems in potential theory. Next, the eigenvalue problems of classical and quantum mechanics are discussed. The last chapter deals with the propagation of radio waves and serves as an illustration of many of the general methods developed in earlier chapters.

The chief merit of the book lies in its skillful handling of complex problems, by the use of a minimum of mathematical formalism and a maximum of physical intuition. Mathematicians will miss the rigor in statements and proofs that they are accustomed to (there is hardly any discussion of convergence, although infinite expansions appear in all parts of the book) and will not accept the author's "uniqueness axiom for physical boundary value problems" (p. 248) as a substitute for difficult uniqueness proofs. On the other hand, the physicist will feel completely at home in this book and he will be grateful

for a concise and very readable text that offers him the true physicist's insight in place of the mathematician's epsilons and deltas.

MICHAEL GOLOMB

Purdue University

Acoustic Measurements. Leo. L. Beranek. New York: John Wiley; London: Chapman & Hall, 1949. 914 pp. $7.00.

In *Acoustic Measurements* Dr. Beranek gives us a handbook covering the basic procedures followed, and the instrumentation required, for the measurement of sound. Theory and practice are blended to make a volume that is at once a compendium of detailed information and a summarizing textbook. It should prove useful to anyone concerned with acoustics.

The twenty chapters cover an extraordinary variety of topics, ranging from the anatomy of the ear to a description of the testing rooms of the National Physical Laboratories in England, and from the mathematical basis of a reciprocity calibration to a list of words used in articulation testing. In each case, ample illustrative material complements a clearly written text.

Considered individually, most of the chapters present information of interest to those who require a "how-to-do-it" book. For example, descriptions of common microphones, with diagrams, show the essential details of their construction, the text and figures illustrating their weak and strong points as tools. Sound sources and sound analyzers are similarly handled. Knowledge of the facts presented should enable the reader to make an intelligent choice of the device that will best serve his needs. A further point: the author's care to define the limitations of his instruments and procedures alerts the reader continuously to the pitfalls inherent in such measurements.

Considered together, the chapters make a comprehensive textbook, complete with subject and author index and a glossary of terms. The bibliography is distributed as footnotes, and some 85 percent of the references are to publications in English. Although certain of the topics seem less adequately treated than others, the effort to cover the entire field has, on the whole, been successful.

ROBERT GALAMBOS

Harvard University

Algebraic Curves. Robert J. Walker. Princeton, N. J.: Princeton Univ. Press, 1950. 201 pp. $4.00.

Plane geometry in antiquity concerned itself for the most part with the straight line and the conics, studied by synthetic means. It was only with the introduction of analytic methods in the 17th century that it became possible to consider algebraic curves in general. Since that time a large number of particular curves have been exhaustively studied, and an extensive and beautiful theory of algebraic curves has been developed. It is with this theory that the present book is concerned.

Although the subject matter is classical, the author has made use in his exposition of some of the concepts of modern algebra, such as fields, ideals, and valuations. At the same time, he has set himself the task of keeping the treatment on as elementary a level as possible. In this objective he has admirably succeeded. Very little previous knowledge of algebra on the part of the reader is required, since the first chapter is entirely devoted to algebraic preliminaries, and further algebraic concepts are introduced throughout the book as needed. The second chapter develops the necessary material on projective spaces.

The subject matter of the book proper begins with Chapter III. Here are discussed plane algebraic curves, their singularities, and the reduction to ordinary singularities by quadratic transformations. By means of resultants, Bezout's theorem is proved in a weak form: The number of intersections of two curves is at most the product of their degrees. The full theorem of Bezout is proved in Chapter IV, after the introduction of formal power series and the definition of a place of a curve. These notions are then used to prove Noether's theorem also. Chapter V deals with space curves and with rational and birational transformations of algebraic curves. Finally, Chapter VI contains the theory of linear series and the Riemann-Roch theorem.

There are a large number of excellent exercises, ranging from the very elementary to the quite difficult. It is pleasing to note that the author has not contented himself with merely developing the general theory but has applied it, both in text and exercises, to various special curves. Many drawings are given, and these will be found very helpful.

This book should make available to a wide class of readers the classical theory of algebraic curves.

IRVIN S. COHEN

Massachusetts Institute of Technology

The Theory of Probability: An Inquiry into the Logical and Mathematical Foundations of the Calculus of Probability, 2nd ed. Hans Reichenbach. Translated by Ernest H. Hutten and Maria Reichenbach. Berkeley and Los Angeles: Univ. of California Press, 1949. 492 pp. $12.50.

This book is the English version of the author's "*Wahrscheinlichkeitslehre*" of 1935. Several changes—which, however, do not bear upon the essential contents—are listed in the preface. Reichenbach's theory is an attempt to combine and to reconcile two different concepts of probability: the mathematical notion of numerical probabilities which underlies the so-called calculus of probability, and the entity of phenomena to which the terms *probable* and *improbable* of everyday language usually apply. The main characteristics of his conception are that he accepts the frequency interpretation in the calculus of probability without introducing a randomness

concept and that he claims for the probability theory an over-all importance as being "the nucleus of every theory of knowledge" (p. v).

The first chapters of the book are an introduction to the more or less elementary problems and methods of probability computation. Much use is made hereby of the modern notations of symbolic logic. What the reader finds here can be found in a more conventional form of notation in most mathematical texts. In fact, it is not difficult to prove that, if one writes down all natural numbers starting with 1, 2, 3, . . . and continuing up to the highest 100 digit number, only 20 percent of these numbers will include more than 12 fives. But it is a long way from this arithmetical fact to the statement that in putting down one set of 100 digits at random one has an 80 percent probability of getting less than 13 fives. This gap cannot be bridged by any display of formulas of symbolic logic. It would require a clear-cut definition of what is meant by random, but the author has not given such a definition. The examples he uses to illustrate the theory are of a different type. He goes to great lengths, for instance (pp. 254–257), in dealing with the case of a Dr. B., who was suspected of murdering his wife in order to collect insurance benefits. The starting point is a statement of the insurance company that four out of five husbands who take out large amounts of life insurance for their wives do so with criminal intentions. After a lengthy calculation which takes into account several instances of possible murder the result reads: "The probability of murder, on the basis of the known facts, is therefore 84%. What makes this value even higher than the antecedent probability of 80% is the fact that the insured person died, and not of a natural death" (p. 257). Computations of this type are often used to discredit the calculus of probability in the public eye.

The eighth chapter introduces a new idea under the heading "Theory of Probabilities of a Higher Level." Its main purpose is to justify the "inductive inference," i.e., the rule that the frequency observed for a finite initial section of a sequence can be identified with the probability controlling the sequence (p. 329). It is not quite clear to the reviewer why the inverse probability, discussed in the preceding sections, should not belong to the probabilities of second level (i.e., probabilities of a probability value).

The last three chapters—9, 10, and 11—are entitled "The Problem of Application," "Probability Logic," and "Induction." In this field lies what the author apparently considers to be the main original achievement of his theory. The multivalued logic is another form of presenting the most elementary probability relations. "Quantitative truth" and "quantitative negation" can, in the last instance, be interpreted only in terms of frequencies. Reichenbach thinks that he needs this new formalism for his theory of induction. Here he discusses such questions as why Newton's law of gravitation has been accepted as a general law when it was checked only by a finite number of tests; why it was discarded in favor of Einstein's theory on the ground that it disagreed with observations in one single instance. He rejects the idea that the unification of theories serves intellectual needs —it simply increases their probability (p. 433). All kinds of scientific statements, each single argument and each comprehensive theory, has a certain assignable probability value, and "all the questions concerning induction in advanced knowledge, or *advanced induction*, are answered in the calculus of probability" (p. 432). These quotations and the following one must be given here without comment. The reader might wish to know what Reichenbach calls the rule of induction and presents in prominent print on page 446:

"RULE OF INDUCTION. If an initial section of n *elements of a sequence* x_i *is given, resulting in the frequency* f_n*, and if, furthermore nothing is known about the probability of the second level for the occurrence of a certain limit* p*, we posit that the frequency* f_i $(i > n)$ *will approach a limit* p *within* $f_n \pm \delta$ *when the sequence is continued."*

No indication is given in the book about the magnitude of δ.

R. v. Mises

Harvard University

Introduction to the Theory of Probability and Statistics. Niels Arley and K. Rander Buch. New York: John Wiley; London: Chapman & Hall, 1950. 236 pp. $4.00.

The first sentence of the preface states that "the purpose of the present book is to give an elementary introduction to the theory of probability and statistics with special regard to its practical applications." Although the book has some excellent features, it is the reviewer's opinion that the authors have been only moderately successful in the objective stated.

In the first place, the treatment is far from elementary, and the style of exposition is condensed. It is doubtful whether it could be read with profit by many students below the postgraduate level, or by anyone who has not reached a considerable degree of maturity in mathematics. (It may be mentioned, however, that this is a translation of a Danish text, and perhaps the average freshman in a Danish university is much better prepared in mathematics than his American counterpart.)

Secondly, the emphasis seems to be very much on the theoretical, rather than the practical, aspects of the subject, and the practical illustrations included are taken from the so-called "exact" sciences—physics, astronomy, engineering, etc. This book would be an excellent introduction to the subject for a physicist (it is the author's impression that it is just the sort of book many physicists ought to read) or a mature mathematician without any previous knowledge of this field. It is difficult to see what other purpose it could serve, as it is too difficult for an elementary text, and not sufficiently comprehensive to be used as a reference book by one who has occasion to apply statistics and probability in his work.

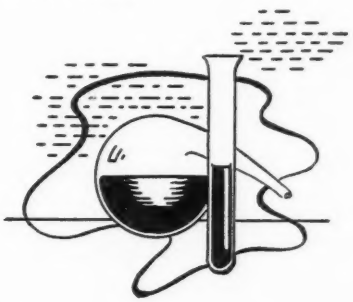
The first seven chapters deal exhaustively with the theory of probability distributions, and the illustrations include a number of such distributions arising in physics, which are probably not familiar to most statisticians. Chapter 8 deals with probability limit theorems and Chapter 9 contains a brief but very able discussion of the relation of the theory of probability to experience

and its practical importance. Chapter 10 develops the theory of estimation, following mainly the approach of R. A. Fisher. Chapter 11 is devoted primarily to the theory of errors, as applied to physical measurements, but includes a somewhat sketchy discussion of the theory of tests of hypotheses. Chapter 12 takes up the application of the theory of probability to the adjustment of physical measurements subject to one or more constraints. For example, measurements may have been made of all the three angles of a triangle, and it is desired to arrive at a set of adjusted values which will add up to 180 degrees. Appendices deal with the gamma function and elementary matrix theory, and tables of certain important distributions are included, followed by a list of 90 problems and a list of 44 bibliographic references.

The authors' statement of their philosophy of statistics is most refreshing and valuable. A highly commendable and unusual feature is the distinction clearly and consistently made throughout the book between the "mathematical model" and the "real world." Also noteworthy is the axiomatic approach to the theory of probability and the careful statement of the assumptions underlying various statistical procedures.

THOMAS N. E. GREVILLE

Federal Security Agency



Infrared Determination of Organic Structures. H. M. Randall, R. G. Fowler, N. Fuson and J. R. Dangl. New York: D. Van Nostrand, 1949. 239 pp. $10.00.

The use of infrared spectra to identify organic compounds and characterize certain structural groupings in these molecules is not new, but recent developments in the technique of infrared spectroscopy (which make the recording of such spectra a routine matter) have caused such rapid development, that the appearance of a book on the method must be very welcome to many chemists and biochemists. To write such a book is no easy task; the method is still so new that, although certain principles can be very easily stated and exemplified, their detailed application to individual molecules presents many pitfalls for the unwary.

The fact that certain common chemical bonds and groupings have characteristic vibration frequencies which, to a first approximation, are independent of the rest of the molecule and so are always observed in approximately the same position in the infrared, makes the method, at first sight, a very attractive and powerful one. The difficulties lie in the degree of constancy of each characteristic frequency and in achieving a clear understanding of the reasons for the small but very important variations. Thus C=O frequencies are generally lower than C=C and C=N frequencies, but in most amides the C=O frequency is in the position normally occupied by C=C or C=N frequencies. It follows that it is just in those cases where the chemist most needs help from the spectroscopist (i.e., when he is on unfamiliar ground) that the spectroscopist is sometimes least sure of his characterizations.

In order to establish a new structure by infrared methods, it is generally necessary to have the spectra of series of model compounds in which the key groupings used in the spectroscopic analysis of the unknown structure have environments closely resembling those of the key groups in the various structures under consideration. This was very well exemplified in the use of infrared spectroscopy to establish the structure of penicillin. The present book derives directly from the work done by the authors on penicillin. The state of the method at that time was such that an extensive investigation had to be made of the frequencies characterizing many chemical bonds, especially those of the C=O, C=C, C=N, and NH bonds in a wide variety of compounds.

The authors make it very clear that their treatment of the subject must in no sense be regarded as definitive or even comprehensive. This is very wise, for it will be several years before the chemist can be given his handbook for the use of this structural tool. As a first step in the right direction, this book can be highly recommended. After a general discussion of the underlying principles, a most useful catalogue is given of frequencies occurring in the range 5 μ–7 μ, commonly known as the "double bond" region, since the key frequencies of the C=O, C=C, C=N, and N=O bonds occur here. A more general catalogue of characteristic infrared and Raman frequencies between 2.6 μ and 70 μ follows, preceded by a short discussion of the methods of assignment and how these are based on complete analyses of the infrared spectra of very simple molecules. A very valuable chapter is then devoted to illustrative examples of the method drawn from the authors' own experience. The experimental techniques employed by the authors are next described in detail and, finally, reproductions are given of the actual tracings of the spectra of over 350 compounds.

The only serious slip noticed is that in the final catalogue of spectra (p. 195) the spectrum of morpholine is wrong and this vitiates the discussion concerning morpholine on page 7. (The spectrum given for morpholine appears to be that of nitromethane.) It is not possible to agree with every one of the assignments proposed but detailed discussion of these cases is not practicable here, and in general only further work would show which view was correct. It might have been advisable, however, to indicate by special marks that certain assignments are beyond question, others are fairly certain, and a few are still open to question. The treatment of the theoretical interpretation has some omissions. In particular, the

very important effects of hydrogen bonding and, more generally, of interactions and variations in charge distribution in altering characteristic frequencies receive inadequate attention. In all other respects, the book is an extremely valuable contribution which forms an excellent introduction to the subject for chemists and those more interested in the practical applications of infrared spectra. For the chemical spectroscopist, it is a storehouse of interesting information, which should prove very stimulating in the fascinating problem of correlating the spectroscopic and chemical properties of molecules.

G. B. B. M. SUTHERLAND

University of Michigan

Titanium: Its Occurrence, Chemistry, and Technology. Jelks Barksdale. New York: Ronald Press, 1949. 591 pp. $10.00.

Growing interest in titanium chemistry and applications of elemental titanium and its compounds in recent years has demonstrated an urgent need for a comprehensive and concise summary of information pertaining to the chemistry of the element. Such a summary is presented in the present monograph.

Although written largely in terms of the titanium pigments industry, and thus reflecting the author's major experiences and interests, the volume nevertheless strikes a comparatively good balance among the technical developments involving titanium materials. Its wealth of information about pigments is supplemented by adequate discussions of uses of the element or its compounds in alloys, in the electrical and ceramic industries, in dyeing processes, and in catalysis. Recent developments involving the production of the pure metal and its applications are discussed, as are miscellaneous applications of compounds running the gamut from gem stones to water purification and sewage treatment.

Emphasis throughout the book is primarily upon technology. Considerable space is devoted to the mineralogy and technical treatment of useful ores for the recovery of compounds of the element. The chemistry of the free element and of its compounds is, however, treated in considerable detail in three chapters, and methods for analyzing titanium materials are considered in one chapter. This last chapter is very brief and appears to be somewhat sketchy in character. On the whole, however, the treatment seems excellent.

Throughout, the book is well documented. References to both technical and patent literature are indicated clearly in connection with statements of fact in the discussion. These references are then collected by chapters into a section of 77 pages, placed just before the index at the end of the volume. The author's statement that these references are complete up to the time when the book went to press appears correct. Indexing is equally comprehensive.

The book is written in a clear prose which is easy to follow and free from ambiguity. In general, the author has been sufficiently critical of conflicting literature reports to render his presentation authentic, although there are some instances where he has not been. One might wish that he had explored more searchingly the basic chemistry of some of the processes he described and had thereby offered more adequate explanations for these processes. In these and most other instances, however, the viewpoint has been more technical than theoretical or experimental. The volume has been given careful handling by the publishers and is thus clearly printed, attractively bound, and free from significant errors. In the opinion of the reviewer, however, the price is excessive.

Barksdale's *Titanium* should prove useful to both technologist and teacher. It contains a fund of information and should fill a vital need in the rapidly expanding field of titanium chemistry. Its use is to be recommended.

THERALD MOELLER

University of Illinois

The Alkaloids: Chemistry and Physiology, Vol. I. R. H. F. Manske and H. L. Holmes, Eds. New York: Academic Press, 1950. 525 pp. $10.00.

This volume is not for the casual reader who seeks a little information on the subject of vegetable bases, but rather for specialists in the alkaloid field, or those who intend to become so. It consists of seven sections, selected apparently on the basis of interests and availability of the authors.

The introductory chapter by Manske, "Sources of Alkaloids and their Isolation," is well described by its title, and offers many valuable generalizations of technique which are more specifically illustrated in the later chapters, where the isolation and separation of individual members is usually given.

The section by W. O. James, "Alkaloids in the Plant," is a scholarly treatment of the subject which assumes more botanical knowledge than is possessed by most chemists. The old and fascinating question of why plants produce alkaloids (and why many do not) is treated in some detail, and leaves us just where we started; we do not know, and perhaps there is no reason to speculate.

There are two excellent chapters by Léo Marion, "The Pyrrolidine Alkaloids," "The Pyridine Alkaloids," which deal with the simple cyclic plant bases, and the commercially and medically more important members of the pepper, areca, lobelia, and tobacco groups, as well as some minor types.

The relatively obscure subject of the *Senecio* alkaloids is considered in elegant detail by N. J. Leonard. Although the plants are of little importance except as a menace to cattle, the alkaloid group is nevertheless of interest as the first known example of the pyrrolizidine ring structure, and for the methodical way in which the nature of the individual members was elucidated.

"The Tropane Alkaloids," by H. L. Holmes, includes such medicinally important drugs as hyoscyamine, atropine, cocaine, and scopolamine. In addition to discussion of reactions and structure, there is an exhaustive table of derivatives and properties which may serve as an up-to-date Beilstein.

"The Strychnos Alkaloids," also by Holmes, makes difficult reading, but any account of strychnine will have

this property. All the important data accumulated prior to 1947 are presented, with emphasis on the interpretation of the facts when discovered, and the gradual evolution from them of the later formulas. The accepted strychnine structure was published by Woodward, Brehm, and Nelson in September 1947, and it is regrettable that this could not have been included to give the first complete story of this remarkable alkaloid. The tables to the chapter list the properties of hundreds of derivatives and represent a vast amount of labor.

Although the editors state in their preface that the pharmacology of the alkaloids will be included, this phase of the project had to be abandoned because of difficulty in assembling contributors.

When completed, this projected series will constitute the most exhaustive and authoritative reference work on alkaloids, and the plan to issue periodic supplements enhances its value.

LYNDON F. SMALL

National Institutes of Health

Chemical Activities of Fungi. Jackson W. Foster. New York: Academic Press, 1949. 648 pp. $9.50.

Every scientist interested in mold metabolism will find it extremely convenient to have available *The Chemical Activities of Fungi.* Nowhere else are as many facts concerning the chemistry of fungi as conveniently arranged. The author, experienced in both the academic and commercial aspects of his subject, has been able to use tools other than the scissors and paste pot.

A list of the 19 chapter titles would constitute a sound synopsis of the book. There are chapters dealing with the chemical nature of mold mycelium, with mutations, with trace element nutrition, and with methodology. Chapters are devoted to each of many of the most important mold products, such as penicillin, citric acid, gluconic acid, and others. Little of importance is omitted.

A writer, freshly liberated from the strait jacket of conciseness prescribed by modern scientific journals, is likely to make full use of his freedom. The present work is probably an example. Reactions become "incriminated" (p. 401), or "motivated" (p. 156); enzymatic effects are "aggravated" (p. 463), and difficulties are "circumnavigated" (p. 599). Much space is occupied by games of intellectual solitaire played by the author. A few examples of these may be given. In the chapter on citric acid, 12 pages are consumed in the erection and demolition of theories concerning citric acid formation before the mechanism finally approved is introduced. On pages 181 to 183 one finds a scholarly examination of definitions of reserve storage material. On page 245 begins an interesting three-page discussion of the familiar concept that seemingly new characters acquired by mutants are in reality due to loss of other characters. Such passages—and they are many—may require space, but will certainly prevent the book from being characterized as a dull compendium. Implicit in the criticism that inordinate space is given to the author's speculations is the appreciation of his ability to produce something more than a catalogue.

Throughout the book are numerous expositions of older concepts. These are first supported in an erect posture, then either knocked down or left to collapse. Although an occasional visit to the graveyard of forgotten theories is both useful and diverting, the mass exhumation often believed essential by authors of scientific books seems more likely to confuse than to instruct. The volume is, of course, not free from mistakes. In a comprehensive treatment of a large subject, occasional errors and inconsistencies serve to identify the work as that of a man rather than of a punch card machine. There are many ideas and conclusions with which this reviewer finds himself in disagreement. This is characteristic, for most readers, of all books in which ideas are to be found. The percentage of the author's ideas to which the reader will take exception will probably be small.

The reader of *Chemical Activities of Fungi* will find it an excellent guidebook to the original literature, and a serviceable textbook. He will find oracular pronouncements, wordy morasses, valuable data, and stimulating ideas. He will probably conclude, with the author, that the work is "an authoritative, critical book integrating and evaluating the field" (p. vii).

M. J. JOHNSON

University of Wisconsin

Advances in Enzymology and Related Subjects of Biochemistry, Vol. IX. F. F. Nord, Ed. New York-London: Interscience, 1949. 760 pp. $9.00.

The ninth volume of this stimulating series of books, like its predecessors, offers a thorough review of a few selected topics. The choice of subjects is not made with the purpose of complete coverage in the field of enzyme chemistry. Instead, each topic considered is given a critical and relatively leisurely examination that embodies much of the reviewer's own opinions. This personal approach, in conjunction with the thoroughness of the treatment, forms the major strength of these volumes. It enables the reviewer to develop his subject not only from the standpoint of present developments but with the important inclusion of past history and its influence on the development of the concepts with which he, but not necessarily the reader, is so familiar.

The 12 reviews presented range in subject matter from the industrial biosynthesis of fats through histo- and cytochemistry, to the metabolism of semen. It is clear that not all of these will be of universal interest. Neverthe-

less, in these days of ever increasing specialization within the science of biochemistry, a volume such as this is of considerable value in stimulating the broad viewpoint so absent in modern production line research.

The articles themselves are well written, by authorities in the various fields, although a few might have been deleted to avoid repetition or published more profitably elsewhere. The section on histo- and cytochemistry, for example, is dealt with in great and useful detail by its author elsewhere in book form. The review on enzyme activity in frozen vegetable tissue is extremely specialized and probably of little use to the average reader. In general, however, the subjects have been wisely chosen and this volume will occupy, with its fellows, an important place in any library of general biochemistry.

C. B. ANFINSEN

Harvard Medical School

Chemical Constitution and Biological Activity. W. A. Sexton. London, W.C.2, Engl.: E. & F. N. Spon, 1949. 412 pp. 55s. net.

For countless generations, in attempting to study the essence of nature and natural phenomena, scientists have been drawn to the problems of structure and its functional concomitants. Aristotle, in the *Metaphysics,* stated that if we search for the elements of existing things without distinguishing the many senses in which things exist, we cannot find them. One of these senses in which things exist is that derived from their acting on or being acted upon by other elements, and although Aristotle felt it impossible to discover what "acting" or "being acted on" is made of, in recent years it is this very aspect of scientific inquiry that has advanced considerably—particularly in one of its most complex aspects, that of interaction in the living organism.

The present volume has been designed to provide a glimpse into the many problems involved in the relationship between the chemical constitution of substances and their action upon living cells. It is made up of two sections: the first, a brief consideration of some of the chemical compounds and processes that play a general role in biological activity; the second, short discussions of subjects "chosen as far as possible in order to provide illustrations of the principles outlined in the earlier chapters." The latter include vitamin B_1, various growth factors, choline and its derivatives, cancer problems, and antigens and antibodies.

Of necessity in a book of this nature, there must be many omissions. Perhaps it would be more effective to limit one's dissertation in this field either to a more or less complete discussion of the fundamental principles involved, or to a few of the specific topics now being assiduously investigated. As it is, from either the chemist's or biologist's point of view the book is sketchy and sometimes disturbingly incomplete. Critical examination of some of the discussions reveals certain peculiarities—for example, the complete acceptance of some questionable concepts concerning the role of acetylcholine in nervous system activity. The meagerness of such sections as that on surface-active agents cannot go unnoticed, nor would one object to mention of other points, such as Pauling's theory of enzyme specificity, changes in electronic configuration, and the biological variables involved in the structure-activity relationship.

Admittedly, integration of our knowledge in this borderline field of biochemistry is essential, and is indeed a monumental task for any one author. Despite its inadequacies, this book should help investigators in many fields of research to broaden their outlook, and to cross some of the imaginary walls erected between so many fields of inquiry. Although the bibliography stops at 1947, the work demonstrates an ever strengthening trend in investigation leading rapidly to the acceptance of physicists, chemists, and biologists in each other's laboratories.

ROBERT G. GRENELL

University of Maryland

Metabolism and Function: A Collection of Papers Dedicated to Otto Meyerhof on the Occasion of His 65th Birthday. D. Nachmansohn, Ed. New York: Elsevier Publ., 1950. 348 pp. $7.00.

Investigators in the fields of biological science are indeed fortunate to have available this collection of 38 papers written by friends, associates, and former students of Prof. Meyerhof, on the occasion of his 65th birthday. Among these distinguished investigators are five who have won the Nobel prize. The various authors bring together and organize research evolving from the important researches of Meyerhof, Warburg, and Hill. The guiding and fundamental work of these masters is reflected and interwoven in each paper.

Building on the foundations of Pasteur, Buchner, and Harden and Young, Meyerhof developed many fundamental principles, such as the extraction of the glycolytic enzyme system from muscle, the discovery that some phosphorylated compounds are rich in energy, and the clarification of the Pasteur reaction. These discoveries have made possible exact measurements and have stimulated biochemistry and physiology for a generation, and will continue to exert their influence as these sciences develop.

The book begins with an excellent tribute to Prof. Meyerhof by his pupil, David Nachmansohn. The papers are then arranged in four groups: Part I, Muscle; Part II, Nerve; Part III, Drug Action; and Part IV, Intermediate Metabolism. Most of the papers have a concise summary in three languages. All but two papers have a selected list of references at the end.

Part I. Muscle. The first paper, by A. V. Hill, "A Challenge to Biochemists," begins with the charming history of his friendship with Meyerhof, and leads gradually into a discussion on the course of events in normal muscular contraction which he and Meyerhof did so much to develop and which he summarizes very concisely.

Through all the papers that follow and in many of the references cited, we see the development of the Meyerhof-Warburg-Hill discoveries. The paper by Hans H. Weber, entitled "Muskelproteine," reviews information on muscle proteins and presents new facts on L-myosin and actin. M. Dubuisson, in "Modifications dans la structure physico-chimique de l'édifice contractile au cours du cycle

de la contraction musculaire'' discusses the contractile apparatus of muscle. A. Szent-Györgyi has a brilliant paper on ''Actomyosin and Muscular Contraction'' by ATP. D. M. Needham has written a critical review on ''Myosin and adenosinetriphosphate in relation to muscle contraction.'' W. F. H. M. Mommaerts, in ''A consideration of experimental facts pertaining to the primary reaction in muscular activity,'' has given a survey of recent developments. Saul Korey discusses ''Some factors influencing the contractility of a nonconducting fiber preparation.''

Part II. Nerve. In the second part Francis O. Schmitt discusses ''Morphology in muscle and nerve physiology,'' and analyzes x-ray and electron microscope techniques. David Nachmansohn, in his ''Studies on permeability in relation to nerve function. I. Axonal conduction and synaptic transmission,'' has presented an excellent analysis of this field. Meyerhof's approach to the study of muscular contraction has also proved valuable in the study of nerve function. M. A. Rothenberg, in ''Studies on permeability in relation to nerve function. II. Ionic movements across axonal membranes,'' points out that studies on the permeability of the giant axon of the squid to potassium indicate that a dynamic, rather than a static equilibrium, exists. Calcium and sodium have also been studied. R. W. Gerard and R. W. Doty discuss ''Nerve conduction without increased oxygen consumption: the action of azide and fluoroacetate.'' Harold E. Himwich, in ''Some evidence on the functional organization of the brain,'' points out that the brain is not a static structure. Alexander von Muralt, in ''The development of muscle-chemistry, a lesson in neurophysiology,'' summarizes the present position in this field.

Part III. Drug Action. H. Blaschko, in ''Substrate specificity of amino-acid decarboxylases,'' studies the decarboxylation by bacterial and mammalian enzymes of a number of amino acids. Chalmers L. Gemmill reviews ''Glycolysis in pharmacology.'' R. Meier and H. J. Bein, in their paper ''Zur Charakterisierung der Spezifität pharmakologischer Wirkungen und des sie bedingenden Rezeptorsystems des Substrates,'' have given a thorough discussion of significant problems in this field.

Part IV. Intermediate Metabolism. L. Michaelis and S. H. Wollman present ''Free radicals derived from tocopherol and related substances.'' Carl F. Cori, Sidney F. Velick, and Gerty T. Cori, in ''The combination of diphosphopyridine nucleotide with glyceraldehyde phosphate dehydrogenase,'' discuss the theory that ''glyceraldehyde phosphate dehyrogenase from rabbit muscles contains two catalytic sites, having dissociation constants with DPN that differ by a factor of 100 or more.'' Carl Neuberg has an excellent article entitled ''Gärung und phytochemische Reduktion''; L. Genevois, ''Essais de bilans de la fermentation alcoolique due aux cellules de levures''; Wilhelm Kiessling, ''Triosephosphorsäure als Intermediärprodukt bei der Zuckergärung mit intakter Hefe''; Gerda Dangschat and Hermann O. L. Fischer, ''Configurational relationships between naturally occurring cyclic plant acids and glucose''; Allan L. Grafflin and Severo Ochoa, ''Partial purification of isocitric dehydrogenase and oxalosuccinic carboxylase''; E. Racker, ''Spectrophotometric measurements of the enzymatic formation of fumaric acid *cis*-aconitic acids''; George Wald, ''The interconversion of the retinenes and vitamins A *in vitro*''; Paul Ohlmeyer, ''Experimentelle Bindung von Eiweisskörpern an Zellkerne und Nukleinsäuren''; Herman M. Kalckar, ''The biological incorporation of purines and pyrimidines into nucleosides and nucleic acid''; René Wurmser and Sabine Filitti-Wurmser, ''L'énergie de formation des complexes dissociables enzyme-substrat et antigène-anticorps''; Bernadette Bergeret, Fernande Chatagner, and Claude Fromageot, ''Nécessité d'un coenzyme pour le fonctionnement de la désulfinicase''; H. A. Krebs, ''Body size and tissue respiration''; André Lwoff, Hélène Ionesco, and Antoinette Gutmann, ''Synthèse et utilisation de l'amidon chez un flagellé sans chlorophylle incapable d'utiliser les sucres''; Gilbert Ashwell and Zacharias Dische, ''Inhibition of the metabolism of nucleated red cells by intracellular ions and its relation to intracellular structural factors''; E. Boyland, ''The biochemistry of abnormalities in cell division''; Fritz Lipmann and L. Constance Tuttle, ''Lipase-catalysed condensation of fatty acids with hydroxylamine''; Shlomo Hestrin, ''Acylation reactions mediated by purified acetylcholine esterase II''; Einar Lundsgaard, ''Observations on a factor determining the metabolic rate of the liver''; and Erik Jacobsen, ''Is acetaldehyde an intermediary product in normal metabolism?''

The final paper, ''The quantum efficiency of photosynthesis,'' by Otto Warburg, Dean Burk, Victor Schocken, and Sterling B. Hendricks, is a classic contribution to science. This work was carried out in the U. S. It is an extension and verification of Warburg's earlier work, clarifying one of the most fundamental problems confronting biochemistry.

The book includes an excellent frontispiece photograph of Prof. Meyerhof and an early photograph of A. V. Hill and Meyerhof together. There are photographs of Meyerhof's laboratories in Berlin in 1928 and in Heidelberg in 1931. On page 338, there is a photograph of Otto Warburg and Dean Burk at work together in Bethesda, and on page 347 a photograph of a group of Prof. Meyerhof's students at the Kaiser Wilhelm Institut für Biologie at Berlin-Dahlem. This page also contains a photograph of Meyerhof and Hill and a group of Meyerhof's students, taken in 1931, at the Kaiser Wilhelm Institut für Medizinische Forschung at Heidelberg. On page 348, there is a picture of the Kaiser Wilhelm Institut für Medizinische Forschung, Heidelberg, and on the lower part of the page a photograph taken at Woods Hole, July 1949, of a group of authors consisting of Meyerhof, Warburg, Neuberg, Burk, Szent-Györgyi, Nachmansohn, Wald, and Korey.

The papers presented in this volume give the outline of a vast structure based in good measure on the fundamental work of Prof. Meyerhof, who won the Nobel prize in 1923 for his distinguished researches on intermediary metabolism in active and resting muscle. Progress in biochemistry and physiology has been greatly speeded by the strong flow of ideas generated in his laboratories.

Finally, one is tempted to philosophize concerning the effect of leadership and organization on scientific productivity. Freedom to carry on activities, uninhibited by administrative formalities and restrictions, with provision of excellent assistance and facilities like those at Berlin and Heidelberg, and a supreme interest in the work being done were significant factors in developing the environment in which creative ability could so flourish.

CHARLES N. FREY

Standard Brands Incorporated

Vitamin Methods, Vol. 1. Paul György, Ed. New York: Academic Press, 1950. 571 pp. $10.00.

The first volume of the treatise on vitamin methods deals with the physical, chemical, and microbiological methods of vitamin assay. The presentation of material has been built around the methods employed for assay, rather than around the assays for a specific vitamin. This permits a discussion of principles involved for each type of assay, which is followed by a discussion of variations in technique for the individual vitamins. Most techniques are given in sufficient detail to be used without consulting additional reference sources. Animal assay methods are to be given in a second volume.

The book is divided into five sections dealing with physical, chemical, microchemical, and microbiological methods of assay, and the use of optical instruments in vitamin assays. In the section on physical methods, assays are described for vitamin A and provitamins A by the ultraviolet absorption spectra technique. The difficulties encountered in the application of this method to the assay of vitamins D, E, K, and B_6 are discussed. Fluorometric assay methods for vitamin A, thiamine, riboflavin, and ß-pyracin are given. Chemical methods are described for vitamin A and carotene, vitamins D, E, and K, thiamine, niacin and niacinamide, pyridoxine, choline, inositol, *p*-aminobenzoic acid, ascorbic acid, and pteroylglutamic acid and related folic acid compounds. Microchemical methods are given for vitamin A and carotene, ascorbic acid, riboflavin, phosphatase, iron, and protein.

The microbiological assay section discusses methods utilizing lactic acid bacteria, yeasts, *Neurospora* mutants, and miscellaneous microorganisms. A particularly useful section gives, in two tables with reference keys, a cross index of vitamin assays, the test organisms, and a key to the details of assay procedure. Another table summarizes the preferred method of assay for each vitamin. Assay methods for *p*-aminobenzoic acid, biotin, choline, folic acid, inositol, nicotinic acid, pantothenic acid, riboflavin, thiamine, and vitamin B_6 are described.

The section on the use of optical instruments should be of value to those selecting apparatus for vitamin assays.

MARY S. SHORB

University of Maryland

Antibiotics. George W. Irving, Jr. and Horace T. Herrick, Eds. Brooklyn, N. Y.: Chemical Publishing, 1949. 273 pp. $6.75.

In the period September 1946–January 1947 the U. S. Department of Agriculture Graduate School sponsored a series of lectures entitled "Progress in the Field of Antibiotics." These lectures (with the exception of three dealing with restricted material on penicillin) have been collected as chapters in *Antibiotics.*

Four chapters are devoted to penicillin. These cover the early history, the wartime developments in England and in this country, the government certification program, the development of high-yielding strains of *Penicillin,* and the advances in commercial production of penicillin. It is regrettable that the lectures dealing with the chemistry and synthesis of penicillin and the production of new penicillins biosynthetically could not be included to round out this section. The clinical uses of penicillin and streptomycin are covered in one chapter, and in another the chemistry of streptomycin is presented in the form of charts and equations. Other chapters deal with gramicidin and tyrothricin, the chemical aspects of antibiotics other than those already mentioned, and the use of antibiotics in veterinary medicine. Four chapters deal with the production of antibiotics by microorganisms, basidiomycetes, actinomycetes, and higher plants.

Each chapter is written by a man who has made major contributions in the antibiotic field. The subjects are necessarily covered in a general way, and results rather than methods are emphasized. Thus, little or no mention is made of the techniques of screening microorganisms for antibiotic-producers, of isolation methods such as adsorption, and partition chromatography, of means of characterizing new antibiotics such as paper chromatography and the Craig countercurrent distribution technique. The various chapters do present in an interesting way the general picture of the development and status of antibiotic research up to January 1947. Selected bibliographical references afford a convenient entry to the literature for those who want more detail.

This book should provide an interesting introduction for those who are not familiar with the antibiotic field and a convenient reference source for those who are.

H. E. CARTER

University of Illinois

Genetics, Paleontology, and Evolution. Glenn L. Jepsen, Ernst Mayr, and George Gaylord Simpson, Eds. Princeton, N. J.: Princeton Univ. Press, 1949. 474 pp. $6.00.

This is a collection of papers presented at the Princeton Bicentennial Conference on Genetics, Paleontology, and Evolution. The conference was arranged by the Committee on Common Problems of Genetics, Paleontology, and Systematics, of the National Research Council, and was held on January 2–4, 1947, under the directorship of Prof. Glenn L. Jepsen.

The Committee on Common Problems was formed in 1942 for the purpose of bringing together paleontologists, systematists, and geneticists in the study of problems of evolution. Another outgrowth of the work of this committee was the founding of the Society for the Study of Evolution, in 1946, and the establishment of the journal *Evolution*, which is published by the society.

The Princeton symposium was a conference of about sixty workers in diverse fields of evolutionary study, chiefly paleontologists, systematists, and geneticists. Several European scholars attended, as guests of Princeton University, and contributed to the program and to the present volume. The scope of the conference is indicated by the following list of topics for discussion, the principal speaker being indicated in each case:

Time in Earth History (Adolf Knopf), Gene and Character (Curt Stern), Gene and Mutation (A. H. Sturtevant), Time Series, Trends, in Animals (A. S. Romer), Time Series, Trends, in Plants (R. W. Chaney), Rates of Evolution in Animals (G. G. Simpson), Rates of Evolution in Plants (G. L. Stebbins, Jr.), Speciation and Systematics (Ernst Mayr), and Adaptation and Selection (Sewall Wright). There was, in addition, a public address on Man's Evolution: Past and Future, by J. B. S. Haldane (*The Atlantic*, 1947, 179: 45.). A summation of the conference, by H. J. Muller, concluded the program. A brochure summarizing the discussion was published by the university in 1948 (Princeton University Bicentennial Conference, Series 2, Conf. 3, pp. 1–36, 1948).

The present volume includes the full text of 23 papers presented by members of the conference. All of the papers mentioned above are included, except that of Sturtevant, and there are in addition papers by E. H. Colbert, D. D. Davis, E. B. Ford, William Hovanitz, Theodor Just, David Lack, H. L. Mason, J. A. Moore, Bryan Patterson, W. P. Spencer, D. M. S. Watson, T. S. Westoll, and H. E. Wood II.

This book does not represent the "synthesis of biology and geology through their common denominator, evolution," which, in Prof. Jepsen's phrase, was the original objective of the committee. It is true that "paleontology studies the results of evolution, while genetics studies its mechanism," but it does not follow that the intermingling of paleontologists and geneticists will result automatically in the elucidation of genetic mechanisms over the broad field of known evolution. Genetics, which in its earlier years was called "experimental evolution," has so far developed valid methods for the study of only a small sector of biological variation. It tells us virtually nothing of the manner of origin of new gene loci. Its results on the nature of genic elements outside the choromosomes are still equivocal. In the allelic mutation of chromosomal genes, on which almost all experimental study of gene mutation has been focused, it cannot yet speak clearly as to the extent and characteristics of subliminal mutation. It has made a major contribution to evolutionary theory in the concept of gene frequencies in equilibrium with evolutionary pressures, a subject covered in this volume in an elegant paper by Sewall Wright. But as to the sources and mechanisms of the variations found in evolution on the grand scale, the development of experimental genetics to date has placed little restriction upon free speculation. The investigation of time series, trends, and rates of evolution, which makes up the bulk of this volume, necessarily remains today, as in Darwin's time, a wholly descriptive science.

This book includes a valuable collection of papers, representing, in many cases with excellent examples, the wide diversity of current work on evolutionary problems.

L. J. STADLER

Yale University

The Vertebrate Body. Alfred Sherwood Romer. Philadelphia-London: W. B. Saunders, 1949. 643 pp. $5.50.

This most recent book of Prof. Romer's bids fair to become one of the leading textbooks in college courses in comparative anatomy. The author, trained in the Columbia school of Gregory and McGregor, and now Agassiz Professor of Zoology in Harvard University, has written an admirable account of vertebrate history and structure.

The book is truly comparative. It avoids overemphasis on human structures, one of the most common faults of textbooks on comparative vertebrate anatomy. The early chapters are devoted to the vertebrate pedigree, to a roll call of the vertebrates, and to an adequate treatment of the animal cell and its physiology. Chapter 5 gives a fairly comprehensive account of early vertebrate development, and a series of chordate forms ranging from *Amphioxus* to Mammalia is treated in a comparative manner.

Eleven chapters are devoted to a consideration, seriatim, of the various organs and organ systems of the vertebrate body. Among the several systems, the skeleton is treated in the most detailed fashion; a section of 112 pages being devoted to this topic. This undoubtedly stems from the author's interest and experience in this particular field, as well as from the fact that this system, drawing from the field of paleontology, offers a splendid opportunity for a really adequate evolutionary story. The muscular system, treated rather briefly by most textbooks, is covered in a rather comprehensive manner. The other organ systems are also well covered, the material being presented in a clear and interesting fashion.

One of the unique features of the book is that, in addition to presenting the comparative anatomy of the various organ systems, it gives considerable attention to the development, histological structure, and physiology of the various structures. A knowledge of the embryonic origin of an organ is fundamental to an understanding of its adult structure, and including histological material makes for a clearer and more interesting study. The relationship of form to function, ignored by many writers in this field, is adequately treated by Prof. Romer. To illustrate this point, the chapter on the muscular system is introduced by an account of the histological structure of the various types of muscle, followed by a consideration of muscle fiber function.

The appendix includes, besides a rather full bibliography and synoptic classification of the vertebrates, a section on scientific terminology. A list of some 600

anatomical terms is given with the definition and derivation of each. This section on etymology should prove particularly valuable to the student.

As is usual with Prof. Romer, this book is most interestingly written. It is not merely a collection of anatomical facts, but rather tells the story of vertebrate history and structure in a clear and lively manner. The illustrations are good and profuse (363 figures), and many of them are original.

Many teachers are reported to have adopted this book sight unseen. It is the opinion of this reviewer that they will be well pleased with their choice.

WILLIAM O. PUCKETT

Davidson College

Principles of Animal Ecology. W. C. Allee, Alfred E. Emerson, Thomas Park, Orlando Park, and Karl P. Schmidt. Philadelphia: W. B. Saunders, 1949. 837 pp. $14.00.

Since Haeckel's suggestion of the term *ecology* in 1870 no group of authors has done more than this illustrious quintet to establish the science on a firm basis.

Among the book's outstanding values are its documentation of many principles on which the evidence was previously widely scattered, its precise statement of the present status of these principles, so that lines of past and present accomplishment and profitable future advance are indicated, and its comprehensive organization of the widespread materials of ecology.

The five principal sections of the book are "The History of Ecology," "Analysis of the Environment," "Populations," "The Community," and "Ecology and Evolution." These are supplemented by an excellent subject index, meticulously prepared, a bibliography, and an author index of nearly 2,500 titles. Great care has been taken to correlate various parts of the book through cross references. A glossary would have been helpful.

The authors rightly make the point (p. 693) that ecology tends to be holistic in its approach. Where most adequate, the book considers its subject matter from the bio-ecological, i.e., the plant-animal, viewpoint. The authors reject the terms "animal formation" and "plant formation" in favor of biotic concepts (p. 582). Unfortunately, the authors felt that, for convenience and workability, they could not extend their work to include the whole scope of ecology (p. vii), the bio-ecology of some writers. But in fact most of their treatment is sympathetically bio-ecological.

The concept of the community as a complex organism, which many authors have discussed without coming to any very widely accepted conclusion, receives full recognition here. Table 30, p. 440, presents a highly convincing comparison of the doctrines of the cell, the multicellular organism, and the community. The reviewer would point out that the community as a functioning organism in many, probably most, instances, is the plant-animal community. This important point is not always made clear by our authors, although it is unmistakably implied or exemplified on many pages.

Note some of the practical implications of this concept of the plant-animal community as a complex organism. Ecology should never be divided, at least in philosophic thought, into plant ecology and animal ecology. The splitting up of the subject into abstracted aspects of restricted scope (one of my students reported taking five courses in ecology in a single institution—plant, animal, forest, insect, and wildlife ecology) is strictly for convenience and may lead to confusion.

The pervasive quality of the order of nature is suggested on page 464, where it is pointed out that there is a parallel between the zonation of a restricted community on granite rock and the major features of the suppositional dispersal pattern of the world biota (Matthew). In both, the primitive types are peripheral and the more highly evolved ones at or near the center.

Tables of stratal equivalents, such as those given on pages 470 and 473, may be of the highest theoretical and practical value, especially in such fields as horticulture, game management, fisheries administration, and agriculture generally.

Under "Natural Selection" (pp. 640 and following) there is a closely reasoned development of the thesis that the concept of competition has often been misapplied in recent years. "The importance of its implications and of its conscious misapplications in human affairs, both in economics and in interclass and international warfare, can hardly be overemphasized." On page 641 appears the significant statement: "Fitness involves cooperation, and adaptations leading to coordination of parts of organisms and of individuals in populations are the result of evolution through natural selection." The action of selection on a unitary population emphasizes the desirability of highly developed cooperation within communities. Indeed, the concept of community selection is probably one of the most important in the entire philosophy of evolution. It dispossesses the tooth and claw theory of survival, the philosophy of the Nietzsches and the Hitlers, and enforces instead the survival value of cooperation, as a controlling selection factor in some cases.

Instances of sacrificial individual or group action are often overlooked. Somatic cells sacrifice the capacity to reproduce new organisms and often die functioning for the benefit of the whole organism (pp. 691–692). Maternal instincts subject the mother to a higher mortality rate than would otherwise be the case. ". . . Survival may well be in relation to humanity as a whole, rather than for the benefit of the few at the expense of the many" (p. 694). "The evolution of greater interdependence between organisms is correlated with progressive evolution" (p. 696).

Ecological indicators or indices, as the authors call them, are given rather sketchy treatment. No mention is made of the important work of Shantz and others in this field, although its theoretical and practical importance has been widely demonstrated. Also there might well have been somewhat more generous explicit reference to the concept of emergence, although it must be conceded that the whole cell-organismal-community concept is a philosophical elaboration in terms of emergence, implicit if not definitely expressed.

It must be confessed that, even with the outstanding and impressive job performed by the authors, the organization of the total body of ecological principles leaves something to be desired. As in reading the dictionary, one tends to lose the thread of the story in the mass of detail. Perhaps the method of composition, by a board of five outstanding and able authors, each with a lifetime of facts, experiences, and observations to place at the disposal of the group, makes inevitable some roughness in spite of the obvious and laborious effort to assure coherence and literary excellence. In this connection the method of work followed is of interest. First the different authors prepared the separate chapters. Eventually all parts of the manuscript were read aloud to the other authors and there was much discussion of questioned points. The result is an extraordinary accumulation of detailed facts, generalizations, and documentations. If the text lacks somewhat in smoothness or in literary felicity, it is quite understandable. Perhaps if one of the distinguished authors would now take the book and rewrite it from a synoptic view, shortening it somewhat, we could count on more rapid appreciation of it by the scientific and general public. But this reviewer does not want to leave the impression that anyone should undervalue the book. Its publication marks a great advance.

WALTER P. TAYLOR

U. S. Department of the Interior,
Stillwater, Oklahoma

Webs in the Wind; The Habits of Web-weaving Spiders. Winifred Duncan. New York: Ronald Press, 1949. 387 pp. $4.50.

American Spiders: A Guide to the Life and Habits of the Spider World. Willis J. Gertsch. New York: D. Van Nostrand, 1949. 285 pp. $6.95.

Here are two books on spiders, so completely different that there is no question of comparison. Miss Duncan is primarily interested in the work of spiders and not in the spiders themselves. Dr. Gertsch is interested in the spiders themselves and looks upon a knowledge of their works and ways as necessary for their complete understanding.

Miss Duncan admits, in the foreword of *Webs in the Wind*, that she knew nothing about spiders when she started to observe them and their daily life. She chose spiders because "they are the only creatures which are full of activity and variety, and yet sedentary. Also ubiquitous." For two years, part of which was spent in New England and California and part in Mexico, she has watched and sometimes sketched those spiders and webs which have come to her notice. The inevitable result of such a program is a little here and a little there but no picture even approximately complete. This is not intended as criticism, for Miss Duncan makes no pretense that she has written an exhaustive treatise for arachnologists; it is rather a story that has been fun to write and will be fun for others to read. As such, her book is a success though some readers will regret that the identities of many of her pets are unknown.

Dr. Gertsch, who has charge of the spider collection of the American Museum of Natural History, chose to write about spiders because he knows about spiders. He is most interested in their classification and so his book is somewhat weighted in that direction. And since a proper classification of any group of animals must take into account not only the physical forms of the members of the group but also the habits and modes of life of the different species, he has included chapters dealing with the life of the spider, spinning, dispersal, courtship and mating, evolution and economic and medical importance. Other chapters deal with the major groups of the spiders themselves. The average reader will probably find the chapters on courtship and mating and economic and medical importance the most interesting. The fantastic nuptial dances of the male jumping spiders seem reasonable when one realizes that until the male has fully identified himself to the female, he is in constant danger of being killed and eaten by his mate. As to the medical importance of spiders in this country, Gertsch comes to the conclusion that only the black widows (*Latrodectus* spp.) are dangerous, and even these not as dangerous as the public in general considers them.

The 64 plates, half of them in full color, add very greatly to the pleasure of the reader. The author is indeed to be congratulated on getting together such a wealth of excellent pictures. The reviewer thinks that it would have been better if the plates had been numbered consecutively instead of in two series, but that is really a minor point. More important, it would seem that more should have been written about the enemies of spiders.

EDWARD A. CHAPIN

U. S. National Museum

Irrigated Soils: Their Fertility and Management. D. W. Thorne and H. B. Peterson. Philadelphia: Blakiston, 1949. 288 pp. $5.00.

The objective of these two Utah State Agricultural College authors was to write a textbook which would provide a source of information on those soils upon which more than one-half of the world's population is dependent, the irrigated soils. They assume that the reader has an elementary knowledge of botany, chemistry, mathematics, and physics and is familiar with concepts of pH, basic exchange, and physical properties of soil.

Some of the topics treated in the 25 chapters are: his-

tory and extent of irrigation, characteristics of arid region soils, soil moisture, plant-soil-water relations, evaluating land for irrigation, source and quality of irrigation water, measurement and application of irrigation water, irrigation practices for various crops, drainage reclamation, land evaluation, nutritional problems, and soil management for specific crops.

In this clearly written, well-illustrated book the authors have attempted to cover too much ground for a textbook to be used by students whose major subject is soils. But it should find wide use in vocational schools and as a handbook for those giving technical advice to farmers.

Along with its fine qualities, the book has some shortcomings. The statement is made that modern irrigation practice began in a specific year. In a practice as old and widespread as irrigation, transitions are gradual and take place over wide areas. In the discussion of soil moisture no credit is given to Buckingham for initiating the concept of capillary potential.

The book provides an excellent up-to-date appraisal of the problems associated with the management of irrigated soils, and should therefore find a wide reading public.

M. R. HUBERTY

University of California, Los Angeles

Elementary Plant Physiology. Stuart Dunn. Cambridge, Mass.: Addison-Wesley, 1949. 164 pp. $3.50. Laboratory manual to accompany text $1.00.

This "brief text," as the author describes it, is exactly that, and as such stands out in sharp contrast to such standard works as those by Miller and by Meyer and Anderson. (Oddly, there is no reference to the second text throughout Dunn's book.) *Elementary Plant Physiology* is the type of text which schools of applied science, such as agricultural colleges, have needed for some time. The general field of plant physiology is adequately covered for a one-semester or one-quarter course.

One virtue of such a short text is that it allows time for discussion and for the review questions at the end of each chapter, which appear to be excellent quizzes for the student on the material just covered. As the author explains, literature citations and bibliography are intentionally brief; however, considering the brevity of the text, they are probably adequate.

When it comes to judging the actual make-up of the book, one can cite both virtues and what appear to be serious failings. The order of chapters is both logical and continuous (structure, absorption, transpiration and translocation, mineral nutrition, photosynthesis, organic constituents, respiration, and growth and movement). To cite a few examples, in Chapter 3 (absorption) the explanation of osmosis and diffusion are extremely clear, simple, and concise, and good examples are used. On page 28 under methods of measuring osmosis the author points to the errors in interpretation of data obtained by the cryoscopic method. Such cautions in a brief text of this nature are well taken. On the other hand one wonders whether in an elementary text an explanation of Donnan equilibrium is advisable, especially in light of the pros and cons to the theory in present-day literature. In certain instances explanations of phenomena are so brief that their value is questionable (e.g., the discussion of the "Perimeter Law" and the researches of Brown and Escombe, attempted in half a page). There is an excellent diagram of a corn plant and the several loci for detection of absorbed radioactive elements in the plant (p. 60). (It does, however, include a slight error, designating intercellular space as stoma.) Chapter 5 (mineral nutrition) is excellent for its general completeness and clarity of explanation and example. The brief historical reviews of such major topics as solution culture (called water culture here) are good aids to further understanding of the subject, as is Chapter 6, on photosynthesis. One might quarrel with the use of the word *function* in relation to the mere *presence* of mineral elements in plant constituents, in contrast to cases where they do have definite physiological functions (e.g., Fe in chlorophyll synthesis, K in protein synthesis, etc.), but this is general throughout plant physiology texts. Although the chapter on photosynthesis is moderately brief, it seems to cover adequately the cardinal points of pigments, factors, conditions, and mechanism. Because of this brevity, however, certain statements are made without much room for flexibility and exception to the generally accepted rule (and in this unsettled area of plant physiology, there are many). For example, CO_2 is said to be available *only* from the air; no mention is made of CO_2 from respiration or CO_2 pickup as in a reverse Kreb's Cycle. However, a good review is given of recent advances in using isotopes as tracers.

In the opinion of the reviewer, one of the most serious omissions occurs in Chapter 7, on organic constituents of plants (carbohydrates, proteins, fats, enzymes, and miscellaneous compounds, 8 pages!). In general the treatment is what one finds in an organic chemistry or elementary biochemistry text, i.e., merely names, structures, and classification. The author missed a grand opportunity to give to students in the applied fields, who do not normally acquire this material in other courses, much pertinent information on organic compounds and constituents composing plant tissues and organs.

One of the best chapters in the book is the last one, Chapter 9, on growth and movement (21 pages). The examples and explanations are very good and clear. As in most first edition texts, a variety of slight errors will crop up. There is one on page 153, where the author gives the impression that one has to work in darkness in making auxin assays, whereas normal red or orange light is generally used. The diagram in Figs. 8 and 9 is a poor one for demonstrating *Avena* curvature assay (the angle referred to is no angle). The author should consult Went and Thimann's *Photohormones*, p. 31, Fig. 10.

In general, then, the text has much to recommend it and has a definite place in institutions that do not have a major curriculum in plant physiology, as well as in agricultural colleges and other schools of applied science.

A laboratory manual by the author accompanies the text. This 50-page manual follows the text closely from Chapter 3 on. Each of the 49 experiments has many selected journal references and good page references from several texts (Meyer and Anderson are included here).

In general, the experiments are short and not too complex for individual performance.

JAMES H. M. HENDERSON
California Institute of Technology

Colloid Chemistry of the Silicate Minerals. C. Edmund Marshall. New York: Academic Press, 1949. 195 pp. $5.80.

This is the first of a series of monographs on agronomy prepared under the auspices of the American Society of Agronomy. The volume is restricted, in the main, to evidence obtained from reasonably pure materials, thus enabling the author to lay before the reader an account from the viewpoint of a participant, in which the advances of the last twenty years are especially emphasized.

After a historical outline, the author takes up silicate structures, silicates based on a three-dimensional framework, the colloidal properties of the zeolites and the structures of silicates with planar frameworks, and the structural interpretation of chemical analysis of the clay minerals. This is followed by chapters dealing with the sizes and shapes of clay particles and with the optical properties of clay aggregates and suspensions, adsorption by the clays and its consequences, clay acids and their titration curves, and ionic exchange reactions of the clays. The book is concluded by three chapters on properties: the electrokinetic properties and mechanical properties of clay suspensions, and sols, and the properties of clay aggregates and films. From this outline of the chapter headings it will be seen that the work is restricted to pure materials, relegating to the background diverse and important applications. In admirable fashion the author has clarified the fundamentals rather than describing the technical details of application. The author has succeeded well in his announced purpose and is to be congratulated.

HARRY B. WEISER
Rice Institute

Fifty Years of Plant Physiology. Th. Weevers. Amsterdam, Holland: Scheltema & Holkema's, 1949. 308 pp.

This contribution to the history of plant physiology covers the years 1895–1945, with special emphasis on Dutch investigators and their works. Since many of these are unfamiliar to American physiologists, their inclusion here is one of the chief assets of the volume, although it tends to overbalance the work of plant physiologists of other countries and thus gives a one-sided picture of the development of the science.

In plan the book is modeled so faithfully upon Hugo de Vries' *Textbook of Botany* that it practically forms a sequel to it. However, in the past fifty years the science of plant physiology has expanded and branched out in many directions unimportant or unheard of in the time of de Vries. The result is that the book seems overloaded in such fields as tropisms and other movements, and inadequate in such fundamental aspects of growth as photosynthesis, water relations, and enzymes. Even after a careful perusal of the entire volume, the reader lacks a well-rounded concept of plant physiology in 1945. However, the book is a valuable addition to a physiologist's library for the sake of its bibliography.

RUTH M. ADDOMS
Duke University

Water in the Physiology of Plants. A. S. Crafts, H. B. Currier, and C. R. Stocking. Waltham, Mass.: Chronica Botanica; New York: Stechert-Hafner, 1949. 240 pp. $6.00.

Graduate students in biological science are expected to achieve a somewhat detailed knowledge of a restricted field and a reasonable familiarity with the important ideas and techniques of many associated sciences. The tremendous volume of information that keeps pouring forth in countless technical journals makes this task increasingly difficult. It is quite hopeless to expect graduate students, or even more experienced research workers, to keep abreast of this flood of data, theories, and facts without the assistance of specialists whose critical judgment can bring order and sharper focus to the work in their spheres of interest. The rapidly growing number of reviewing journals, monographs, and articles is tangible evidence that this problem is appreciated and that efforts are being made to provide at least a partial solution.

The volume under review is a contribution of this kind. It endeavors to bring together in readable form both the historical and the modern ideas about water and its role in the physiological processes of plants. Any satisfactory comprehension of water movements in living systems must be solidly based upon an understanding of the chemical and physical properties of water as a chemical compound. It is the recognition of this important point that has prompted the authors to focus attention upon water rather than upon the plant or on specific processes in the plant. This approach to an important segment of plant physiology is something of a departure from tradition, but is sound and logical in its recognition of the close dependence of physiology upon the physical sciences.

The authors first discuss water as a chemical compound and review the various theories that have been advanced to account for its many unusual properties in terms of atomic and molecular linkages. This discussion is followed by a similar treatment of aqueous solutions.

Chapter 4 is devoted to a detailed analysis of osmosis in physical systems from the viewpoint of the physical chemist. In Chapter 5 the terminology common in physiological literature is defined and used in reviewing various hypotheses that have been suggested to account for the origin of pressure in osmotic systems. Although this is still a complex and controversial subject, it seems to the reviewer that the discussion does not dispel all of the confusion that has so long surrounded it.

Attention is then directed to the osmotic systems of living cells and tissues. Particular emphasis is given to

the methods employed to measure the osmotic quantities of plant cells and to their limitations.

In recent years many different lines of experimental evidence have suggested that movements of water between living cells involve physiological as well as purely physical mechanisms. The evidence is described and critically evaluated in a long chapter that bears the rather unfortunate title of "Active Cell Water Relations." The authors conclude that information is still too incomplete to warrant any definite conclusions as to the reality of water movements initiated and maintained in living cells by the expenditure of energy in physiological processes.

The remainder of the book (Chapters 9 and 10) deals with the absorption of water by root systems, its transport through the conductive elements, and its loss in transpiration. The treatment is brief but uneven in the thoroughness with which the various processes are discussed. The restricted treatment given soil moisture relations and the physiology of water absorption undoubtedly stems from the recent publication of an excellent monograph on these subjects.

A concise summary terminates each chapter. All citations of literature are in a single extensive bibliography. Text material is supplemented by many figures.

The book can be recommended to advanced students of biological sciences and to teachers as a very useful presentation of the water relations of the higher green plants. It brings together a great deal of information and the sources from which the data have been obtained. It seems unfortunate that so little attention has been given to the structural framework of the plant within which the physiological processes take place. Full comprehension of physiology must depend upon an appreciation of the relationships between anatomy and the activities located in this framework. In orienting their discussion upon one of the components of the plant rather than upon the interrelationships of the organism as a whole, the authors were limited by the restrictions of their point of view and their treatment fell short of completeness. Nonetheless, the book fills an important place in plant physiological literature and its uniqueness of approach gives it a distinctive flavor which will increase its appeal.

DONALD B. ANDERSON

North Carolina State College

Blakiston's New Gould Medical Dictionary. Harold Wellington Jones, Normand L. Hoerr, and Arthur Osol, Eds. Philadelphia: Blakiston, 1949. 1294 pp. $8.50.

One must live with a dictionary in order to attempt to assess its real value. This the writer has done for several months and hence offers a somewhat belated review.

A sedulous attempt has been made to develop a dictionary along new lines to cover the broad field of the health sciences. Members of the faculty of Western Reserve University School of Medicine formed the nucleus of specialists charged with the responsibility for words and definitions; to this group were added equally eminent leaders in lexicography.

The selection of the words was made after a diligent search of the current literature not only for new terms but also for evidence of change of usage. The drugs described in the latest revisions and editions of the *Pharmacopoeia of the United States of America*, the *National Formulary, New and Nonofficial Remedies*, and the *United States Dispensatory*, and in the various listings of medicinals bearing trade-marked proprietary or other trade names have been included. In order to do this and yet keep the bulk of the volume manageable, it became necessary "to trim away much that clearly is obsolete and valueless."

Pronunciation is shown by syllable division and accent. Eponyms and biographic references have been included with and handled as part of the vocabulary. The illustrations have been grouped in the center of the volume but they are integrated with the rest of the volume by an adequate system of cross references. The selection of the type is good and the excellent spacing makes for unusual facility in finding the words.

The editors and contributors have succeeded in preparing a most useful book and it can be highly recommended. Their wisdom in the choice for deletion of words, such as *aleuronat*, will be evident only after wide usage. It is a bit disappointing to note the omission (surely not a deletion) of the name of Domagk, Nobel laureate in medicine for his work on the sulfanilamides; the etiologic agent of granuloma inguinale given as *Leishmania donovani*; the word spectrum defined without reference to "microbial spectrum"; the statement under Roux: "first used attenuated bacterial culture (anthrax) therapeutically (1880)"; and the "Calmette test" listed as obsolete. These and other shortcomings will unquestionably be rectified in future editions.

MALCOLM H. SOULE

University of Michigan

External Morphology of the Primate Brain. Cornelius J. Connolly. Springfield, Ill.: Charles C. Thomas, 1950. 378 pp. $10.00.

Every important stage of cortical development from lemur to man is dealt with in this monograph. For his study of the 538 brains from more than 50 species, Dr. Connolly had access to the vast collection of the U. S. National Museum. Few, if any, previous investigators have reported on so large a series or on one in which such accurate information was available even on such details as sex and age.

The subjects discussed are: I. The fissural pattern of the primate brain; II. Encephalometry; III. Development of the cerebral sulci; IV. The brain of the newborn and of children; V. The fissural pattern of the human brain (Negroes and whites); VI. Brain and race; VII. The

relation of the sulci to the cortical areas; VIII. Endocranial casts and brain fissuration; IX. Some sulcal relations in the anthropoid and in the human brain; X. The fissural impressions on the endocranial casts of prehistoric man; XI. On homologies and the origin of sulci.

One is disappointed that the text does not deal with the mesial temporal and mesial frontal surfaces of the brain, where the history of the primate brain is the richest and wherein the secrets of phylogenetic development are most effectually concealed. The reason given for this omission is that ". . . it was not desirable to separate the hemispheres in this series" (p. 253). Insofar as the study goes, however, it is a thorough and dependable one, reflecting Dr. Connolly's wide experience in the field. The effort he expended on detail was immense and was wisely channeled into one phase of the over-all subject, namely, the geography of the fissures; his illustrations of the fissures are true and effective, for he has used the Schwarz stereograph in portraying them. Indeed, all of the 337 illustrations are excellent. The bigger problem of the relationship of thalamic development to the configuration of the gyri (of which the fissures are mere boundaries) is not dealt with. His description of endocranial casts of anthropoids and of prehistoric man constitutes an interesting chapter, but interpretation is scanty. The fissural pattern in fetal and adult human brains is treated at some length, as are also the differences in fissuration in Negroes and whites. It is curious that no reference could be found to the duplication of the central sulcus, described in 1882 by Giacomini, in 1907 by Tricomi Allegra, and in 1929 by Gerlach and Weber.

The documentation of the work is admirable. Only here and there can one find instances in which the works of the past could have been put to greater use—for instance, Kuhlenbeck's interesting interpretation of the significance of the lateral occipital gyri (p. 249).

Dr. Connolly's writing is terse and always to the point. His facility of expression makes the text read like a narrative. It is altogether a splendid piece of work.

WEBB HAYMAKER
Armed Forces Institute of Pathology

Illustrated Study Aid for Medical Bacteriology. Walter J. Nungester and Phebe G. Williams. Ann Arbor, Mich.: Edwards Brothers, 1949. 71 pp. $2.00.

This is a picture book. At first glance one might think it had little place among medical texts, but even slight perusal shows that it will take its place as an outstanding supplementary textbook in bacteriology.

Although the preface states that this is "strictly an experiment" it is the reviewer's opinion that the work in its present form has evident value for students studying medical bacteriology and immunology, postgraduate groups reviewing this subject matter, and teachers wishing to use the pictorial material for the preparation of lantern slides or directly on opaque projectors.

The technique of summarizing facts in charts and diagrams is here followed to its logical conclusion. It appears that few, if any, aspects of bacteriology cannot so be treated, as evidenced by the major divisions of the book: Types of Pathogens, Classification, Distribution and Spread of Pathogens, Disinfectants, Infection and Resistance, Immunology, Laboratory Diagnostic Procedures, Chemotherapy, Review of Diseases, Techniques and Methods.

Under each major heading is found a group of related charts and diagrams. Most are self-explanatory; a few assume some knowledge on the part of the reader, and all provide the nucleus of more or less extended discussion, depending on the group interest. The section previewing diseases has the most charts—40 out of a total of 131. The chart of each disease summarizes the pathology, nature of the pathogen, clinical and laboratory diagnosis, treatment, spread and prevention.

The potentialities of this work well warrant the extended version that the authors contemplate.

STANLEY MARCUS
University of Utah, College of Medicine

Clinical Pathology: Application and Interpretation. Benjamin B. Wells. Philadelphia-London: W. B. Saunders, 1950. 397 pp. $6.00.

The first laboratory employing the microscope for the diagnosis of infectious diseases was established by Pasteur at Alais in 1865, in connection with his investigations on pebrine of silkworms. The malady was controlled by destroying the ova of moths found infected by microscopic examination. In order to put this procedure to practical use, girls were taught how to make the necessary examinations. In this way the training of laboratory technicians was included as a function of the diagnostic laboratory at a very early date. Seventeen years later, Koch, in his monumental work on tuberculosis, called attention to the necessity of microscopic examinations of sputum for the tubercle bacillus, to confirm diagnosis of pulmonary tuberculosis. The teachings of these two gave to the diagnostic laboratory its true place in medicine.

Clinical pathology was not generally accepted as a specialty in the United States until the second decade of the present century. The wider application of serological methods, a multiplicity of biochemical tests, the assay of hormones and vitamins, and the determination of susceptibility and resistance of microorganisms to the sulfanilamides and antibiotics necessitated the bringing together of individuals skilled in the various branches of serology, biochemistry, endocrinology, and bacteriology to carry out the multitude of highly specialized techniques. The connecting link between these laboratorians and the practicing physician is the clinical pathologist; trained in medicine and skilled in the interpretation of the results obtained by the experts, he brings to the clinician a clearer understanding of the value and limitations of laboratory findings as they affect the patient.

It is essential for the physician to know what laboratory procedures are available and what they may contribute to the problem confronting him. The book by Wells will provide this information. There are nine chapters, the first seven of which deal with: laboratory procedures generally applicable to the study of infectious diseases, diseases of the gastrointestinal system, diseases of the re-

spiratory system, diseases of the kidney and urinary tract, diseases of the blood, diseases of the cardiovascular system, and metabolic and endocrine disorders. Chapter eight deals with clinical laboratory studies in surgery and chapter nine with clinical laboratory studies in obstetrics. In an appendix, the author, with the assistance of A. E. Moon, has presented a rounded-out discussion of laboratory aids in symptom diagnosis.

The book is well written and the author has selected wisely among the plethora of tests now available. Although the volume is neither a textbook nor a laboratory manual it is highly recommended for the practicing physician and the medical student.

MALCOLM H. SOULE

University of Michigan

Haemoglobin: A Symposium Based on a Conference Held at Cambridge in June 1948 in Memory of Sir Joseph Barcroft. F. J. W. Roughton and J. C. Kendrew, Eds. London: Butterworths Scientific Publs.; New York: Interscience, 1949. 317 pp. $8.50.

Sir Joseph Barcroft was remarkable at least as much for his human qualities as for his outstanding scientific achievements. In his courage, vitality, and enthusiasm, and his affectionate understanding of other human beings, he aroused in his associates personal loyalty and devotion that is given to few scientists. He died suddenly in 1947 at the height of his activity, although he had been retired from his professorship for ten years, and the depth of his influence can be felt in reading the proceedings of this conference, which give a vivid and comprehensive summary of our present knowledge of hemoglobin.

The volume opens with personal tributes to Barcroft, and reminiscences, by E. D. Adrian, Sir Henry Dale, A. S. Krogh, C. G. Douglas, A. V. Hill, R. A. Peters, G. S. Adair, and F. J. W. Roughton. All are admirable and well worth reading, both for those who knew Barcroft personally and those who did not. They help to round out the picture of the man that one obtains from his own vividly written books and papers.

The rest of the present volume is concerned with current investigations on hemoglobin, many directly inspired by Barcroft himself. Here it is impossible even to mention all. Important considerations on the fundamental structure of hemoglobin are advanced by L. Pauling, J. Wyman, Jr., M. F. Perutz, and several others. J. C. Kendrew presents important conclusions, derived from x-ray studies, on the crystal structure of horse myoglobin. The molecule appears to consist of a single layer of folded polypeptide chains, with the plane of the heme group nearly at right angles to the protein layer. This corresponds to Perutz's four-layer structure for horse hemoglobin. Kendrew and Perutz also supply a helpful general discussion of x-ray crystallography of biological macromolecules, addressed to the nonexpert. Important data on amino acid composition are given by G. R. Tristram and by A. Rossi-Fanelli. R. R. Porter and F. Sanger discuss the terminal amino groups of the peptide chains of several hemoglobins, with interesting zoological correlations. E. M. Jope gives valuable data on absorption spectra. There are several studies on the important problem of the differences between adult and fetal hemoglobins; notable are the solubility studies of H. M. Jope and J. R. P. O'Brien, and of M. J. Karvonen. G. S. Adair, and H. Gutfreund, discuss important osmotic pressure studies. H. Barcroft, Q. H. Gibson and D. C. Harrison, and also W. N. M. Ramsay, have valuable contributions on ferrihemoglobin (methemoglobin) in normal blood and in disease. C. Rimington discusses the biosynthesis of heme. F. J. W. Roughton, J. W. Legge, and P. Nicolson present briefly their new data on the kinetics of hemoglobin in solution and in the red cell, and Roughton treats the intermediate compound hypothesis, with conclusions differing in important respects from those of Wyman; these and other disagreements which the reader will note in the book should stimulate further research. D. L. Drabkin describes his work on the accurate determination of the oxygen dissociation curve; H. E. Davenport describes the extraordinary hemoglobins of the worm *Ascaris*, and H. P. Wolvekamp discusses hemocyanin.

Many of these papers briefly present conclusions published elsewhere in greater detail. Others give information which as yet can be found nowhere else. Every contribution deserves close attention, and, in spite of its high price, the book can be recommended most warmly to everyone interested in the structure of this extraordinary class of macromolecules. It is a worthy tribute to Barcroft, whose living influence inspired the conference and the book which issued from it.

JOHN T. EDSALL

Harvard University

Malariology: A Comprehensive Survey of All Aspects of This Group of Diseases from a Global Standpoint. Mark F. Boyd, Ed. Philadelphia-London: W. B. Saunders, 1949, 2 vols. 1643 pp. $35.00 a set.

The reviewer cannot do better than quote, as the purpose of this book, the opening sentence of the foreword: "It has been the Editor's intention to make this volume a working manual of malariology, a comprehensive and adequate review or factual survey of all available knowledge relating to malaria objectively presented and brought down to date."

This objective is reached with the aid of 65 contributors who have dealt with the problems of malaria from either an abstract or practical standpoint. There are 70 chapters grouped in five sections as follows: Section I. Introduction, one chapter; Section II. Parasitology, eight chapters; Section III. Definite Hosts, 15 chapters; Section IV. Intermediate Host, 25 chapters; Section V. Control and Eradication, 21 chapters. In Appendix I, the equipment for field and laboratory investigation is listed with descriptions and available sources. Appendix II is captioned: Provisional Directory of Manufacturers and Distributors of Equipment and Supplies for Anti-Anopheline Operations. The author and subject indices are unusually comprehensive, occupying 153 pages. The first 31 chapters are in Volume I; Chapters 32–70, with the appendices and indices, compose Volume II.

The prodigious toil of editing 1,477 pages of text was mitigated for Dr. Boyd by his enthusiasm for his subject and the satisfaction of knowing he was making available in this book an encyclopedic coverage of malaria on a global basis, tinctured by the richness of his own experience. As the reader passes from chapter to chapter the expected conflicts in views and contrasts in expression are not encountered because of meticulous attention to detail in editing and selection of the figures.

The great merit of this monograph is that it assembles in compact form all that is really known about malaria.

MALCOLM H. SOULE

University of Michigan

Physiology of Heat Regulation and the Science of Clothing. Prepared at the request of the Division of Medical Sciences, National Research Council. L. H. Newburgh, Ed. Philadelphia-London: W. B. Saunders, 1949. 457 pp. $7.50.

Much credit is due the editor who has assembled under a single cover this authoritative, definitive, thoroughly integrated, and instructive series of chapters, contributed with apparent enthusiasm by scientists, all eminent in their own fields. The book will well serve as comprehensive reference material in the fields of heat regulation and environmental physiology. It will present to the heating and ventilation engineer and to the architect the complete relationship between many factors, both physical and physioligical, that reflect on man's health, comfort, and efficiency in any climatic environment. Finally, it will offer the clothing designer and materials engineer a rationale which can readily replace much of the empiricism so prevalent in their professions in the past.

The book is divided into two parts, the first a series of nine chapters on "Human Response to the Climatic Environment," the second three chapters on "Clothing, a Thermal Barrier."

The opening chapter by Wulsin immediately excites the reader's interest by outlining the many sociological and anthropological factors involved in adaptation to cold and hot climates among non-European peoples, such as the Eskimo, the Mongols, the Fuegians, and those tribes living in the Near East, the Sahara, southeastern Asia, and Central America. One leaves this chapter wondering *why*, in terms of physics and physiology, these peoples react to their climatic environment as described. The succeeding chapters provide a partial answer to this question. The biophysics of thermal exchange between man and his environment is described very clearly in chapters by Yaglou and Hardy. Then follows a long, analytical, original, and masterly chapter by Bazett on temperature regulation. Various aspects of physiological adjustment to heat and cold are covered in chapters by Robinson, Spealman, Day and Herrington. The first part ends with a chapter by Yaglou on indices of thermal comfort.

The second part of the book essentially attempts to reduce the problem of adequate clothing to a rational use of physical formulas, of insulating materials produced by man or animal, and of climatic data associated with various geographical areas. Fourt and Harris adequately cover the physical properties of clothing fabrics. Then follows a long chapter comprising a series of essays introduced by Forbes and prepared by Adolph, Robinson, Belding, Spealman, Van Dilla, Day and Siple. Each essay describes, in terms of the particular interests of its authors, laboratory and field methods of evaluating physical and physiological properties of complete clothing assemblies on and off man. The second part concludes with a unique chapter by Siple relating the principles of clothing design to occupational specialty and climate.

At the end of the book is an appendix with definitions of new and old concepts such as *caloric content, Clo, effective temperature, mean skin temperature, net metabolic cost,* and *wind chill.* The appendix also includes miscellaneous information on the metabolic cost of various activities and concludes with a useful conversion table between thermal factors in the cgs system conventionally used by scientists and in the British system generally used by engineers and laymen.

Because of its varied authorship there is some duplication of fact and formulas, all of which may be necessary to make each chapter reasonably complete. The editor has quite wisely allowed each author free reign as to opinion and presentation. As the editor points out in the introduction, the book does not presume to give final answers. Since the manuscripts for this book were prepared, new studies have been reported in the literature, by both military and civilian groups, that can well supplement and clarify this information.

A. P. GAGGE

Aero Medical Laboratory,

Wright-Patterson Air Force Base

Physiology of the Eye: Optics, Vol. 1. Arthur Linksz. New York: Grune & Stratton, 1950. 334 pp. $7.50.

Optics: The Technique of Definition. Arthur Cox. New York: Pitman Publ., 1949. 412 pp. $5.75.

On first thought it seemed illogical to review these two books together, for they cover different material and their purposes and approach are not at all alike. There is, however, a certain similarity between them. Each book is written for a specialized purpose: the one for the student ophthalmologist who should be well acquainted with the properties of light and the laws of optics as they concern the human eye; the other for the thoughtful individual who wishes to understand all about the photographic lens, or "eye" of the camera. Either reader would profit by reading both books, and would thus become aware of the many properties shared by the human eye and the camera.

The first volume is the outcome of Dr. Linksz' long experience in teaching this subject to those of the medical profession who intend to specialize in ophthalmology. The book opens with an introductory section on physical optics, the wave and corpuscular natures of light, spectra, the photoelectric effect, and photometry. The large central portion of the book gives a detailed presentation of geometrical optics, and concludes with a discussion of the eye as an image-forming mechanism. The style is most

unusual and refreshing, for Dr. Linksz follows his lectures closely, and, in places, perhaps verbatim. Through teaching optics to advanced and mature students whose only previous exposure to physics was probably in early college days, he has had an unusual opportunity to discover where the difficulties in grasping the concepts of optics really lie. As a result, the reader is led over the obstacles in the path and is shown the pitfalls in passing. Geometrical optics, so often presented as a series of algebraic gymnastics, is here made a live and interesting subject by the author's constantly pointing out connections with optical phenomena and presenting many examples. The ophthalmologist who reads and understands this book will approach his subject with a broader background and a better understanding of the optical properties of the eye. He will also be apt to be more tolerant of the patient who may dare to query him concerning phenomena of vision. The physicist may well read this book, too. He will react at first with considerable amusement at the lengths to which Dr. Linksz goes to explain obvious subjects, such as the action of mirrors, but on second thought he will realize that the simple laws of optics are not obvious to the student meeting them for the first time, and he may well learn a great deal concerning the teaching of optics from this book.

Optics; The Technique of Definition covers the subject of lens theory and geometrical optics from the point of view of the practical man who wants to learn as much as he can about the performance of photographic lenses without becoming involved in any but the simplest algebra. Each subject is approached from the experimental point of view and with the aid of many well-planned diagrams. As a result, the reader can obtain answers to most of his questions about lenses and at the same time gain a good understanding of the nature of the optical phenomena taking place. An example of a subject well treated here is the focal length of a complicated lens. The explanations of equivalent, front and back focal lengths, nodal points, and principal planes are given clearly, together with detailed instructions as to their measurement. The reasons for the various steps are well explained. The section on testing lenses for definition and aberrations is of particular value. This, together with a very complete listing of commercially available lenses and a qualitative description of their properties by basic type, offers a guide for the intelligent purchase of a lens for a particular purpose, and for testing its performance. The book is up to date and covers, in brief, such recent developments as low reflection coatings and reflection-type lens systems.

RICHARD TOUSEY

Naval Research Laboratory

Sight, Light and Efficiency. H. C. Weston. London W.C.1: H. K. Lewis, 1949. 308 pp. 2£ 2s. net.

The British Coal Mines General Regulations of 1947, concerned with improving the conditions of underground lighting, are based on the premise that good illumination not only facilitates the mining operations and decreases accident liability, but is a basic amenity as well. This philosophy, reflecting the dual function of industrial lighting, also characterizes Weston's approach.

Illumination is an environmental variable which, together with sight—a "personal" variable—affects work efficiency in a large number of industrial operations. What are the values of these variables needed for efficient work? This is the basic problem of Weston's book.

The introductory chapter on the structure and function of the eye is followed by the discussion of the causes and symptoms of eyestrain, defined as a condition due to the overactivity of the ciliary or oculomotor muscles; occupational demands upon sight (e.g., perception of fine details, color discrimination, depth perception, recognition of objects in motion or exposed to view for a short time); facilitation of visual tasks (correction of errors of refraction, acquisition of visual skills, use of special magnifiers and work glasses, provision of suitable color and brightness contrast between work object and the surroundings); lighting and visual efficiency (illumination required on work objects, individual differences in light need, methods for illuminating work objects, glare, spectral quality of light); incentive value of light and color; testing sight for work; and protection of sight.

In presenting the data on his central theme—the relation between illumination and output—Weston relies heavily on the results of investigations made with the support of the (British) Medical Research Council and the Department of Scientific and Industrial Research. These government-sponsored research bodies provided facilities and personnel for long range study of industrial physiology and psychology, including investigations on vision and lighting. The author served for thirty-odd years as investigator for the Industrial Fatigue (Health) Research Board and published a number of valuable contributions in its reports. He carried out extensive field investigations—"naturalistic" and experimental—on illumination and output, but did not neglect laboratory studies of "synthetic" visual tasks, made under rigorously controlled conditions and allowing experimental analysis of the critical visible characteristics (such as size, contrast, and motion) of the work objects. It is Weston's considered judgment that "It is largely to the results of laboratory investigations that we must look for a scientific basis for lighting practice" (p. 170).

Recommended levels of illumination are a practical fruit of research on lighting and vision. In this country, the matter is still highly controversial. As is frequently the case, lack of clarity and agreement about objectives, and inadequate experimental evidence had their share in making the controversy prolonged and, at times, bitter. The British, and Weston specifically, are less exposed to criticism on either count. For very fine objects, there is a continuing increment of performance over a large range of illumination intensities, with an approximately logarithmic relationship between illumination and performance. Weston recognizes that "maximum visibility" is not a practicable criterion of recommended illumination and proposes that a submaximal (90 percent) level of relative performance be used. The detailed schedule of levels of illumination, recommended in the (British) Illu-

minating Engineering Society's *Code* (1949), is presented in the appendix.

The summary of the British researches on illumination and output will be welcomed by many who do not have easy access to the original work. As a whole, the volume will be valuable to all concerned with matters of vision and lighting in factory and mine, office and school.

JOSEF BROŽEK
University of Minnesota

Text-book of Ophthalmology: The Neurology of Vision, Motor and Optical Anomalies, Vol. IV. W. Stewart Duke-Elder. St. Louis, Mo.: C. V. Mosby, 1949. 3473–4627 pp. $20.00.

This great work should command a prominent place on the desk of every ophthalmologist, for it is a masterly compilation of an enormous amount of important information, written in the superb and unexcelled style for which its author is famous. As stated in Vol. I, the aims are to present a survey of authoritative opinion and to provide a reference textbook of ophthalmology.

The printed work—with its connotation of authority and final truth—easily molds and fixes the impressionable mind. Since ophthalmic thought is profoundly affected by the powerful influence of the literature, it is essential that this major publication receive careful scrutiny by the profession. The value of any book should be enhanced by an appreciation of its weaknesses.

The 1154 pages of text are divided approximately equally into three sections, dealing with neurological, motor, and refractive disorders of the eye.

Section XIV, on "Neurology of Vision," discusses the visual pathways, disorders of the higher visual centers, and anomalies of the pupils. In the visual field charts the solid black area outside the peripheral isopter implies absolute blindness which usually does not exist; visual function would be elicited if this area were tested with a stronger stimulus. This practice of blacking an area is detrimental to the valuable concept of quantitative perimetry. Many x-rays, shown as positives, would be more instructive if printed as negatives as they are usually viewed.

The chapter on the pupils is based largely upon Lowenstein's elaborate studies with which the informed ophthalmologist should be familiar. These data are well tempered with a description of the pupillary reactions revealed by ordinary clinical methods, which must serve us until pupillography is established as a routine procedure.

Section XV, on the "Motor Anomalies of the Eyes," presents chapters on the anomalies of the ocular movements and binocular fixation, concomitant and noncomitant squint, ocular deviations, and pathological nystagmus. This section is a most welcome contribution to both the beginning resident and the advanced surgeon. It cleverly and tactfully interweaves with diplomatic acceptance and rejection the conflicting views of many authors. A tangled skein of contradictory concepts is unravelled into a continuous thread, which carries one logically through a sound consideration of the physiology, pathology, diagnosis, and treatment of all types of motor disorders. A serious study of this material will improve the confidence of any ophthalmologist in his approach and treatment of these cases encountered in daily practice. I believe this is the most valuable section in the volume.

Section XVI, on "Optical Anomalies of the Eye," considers errors of refraction, anomalies of accommodation, aniseikonia, eyestrain and visual hygiene, and clinical optical appliances. Especially excellent is the discussion on the nature of emmetropia and ametropia as regards the relative roles of refractive power and axial length in the determination of the total refractive state. Duke-Elder deserves great credit for bringing this long overdue information to our attention. His attitude toward cycloplegic drugs and his broad principles employed in the treatment of ametropia are packed with sound logic and common sense.

With sincere respect for this work, however, the reviewer disagrees with the scattered comments criticizing the subjective determination of refractive errors. On page 4397 it is stated that the aim of refraction is "to provide the patient with the optical correction nearest to the optical ideal with which he sees best and is most comfortable," and that few patients possess the attributes of intelligence, cooperation, and observational ability to any great degree and therefore accurate results cannot be attained often. In my experience most patients do possess these qualities, if the subjective methods employed are correct. The descriptions of subjective methods are inadequate and one could not learn from them how to proceed with a subjective determination. The short paragraph on the cross cylinder, page 4405, is ambiguous and reveals a lack of familiarity with this valuable instrument in its use for measuring cylindrical power.

Resident ophthalmologists should be aware that subjective refraction, properly performed, is a necessary procedure and is highly respected in the United States. A number of leading American ophthalmologists employ subjective refraction almost exclusively.

The factual value of the book is largely dependent upon that of the original articles listed in the bibliographies. Careful study of these articles reveals conclusions that frequently appear unwarranted upon the basis of the accompanying experimental and clinical data. Fortunately, Duke-Elder usually evaluates his abstracts, but some statements are recopied that have failed the test of time; so one must read always with skepticism and accept or refuse the statements as justified by his personal experiences.

The inferior quality of many articles is frequently hidden in the cloak of Duke-Elder's masterful command of English. Considering the great amount of unworthy literature in our libraries, however, one realizes that he has done an admirable job of extracting the excellent and excluding the inferior.

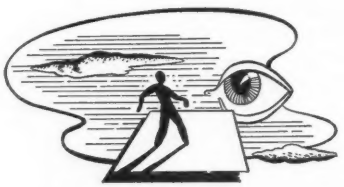
The best writing is in the longer passages, notable for the absence of frequent parenthesized references which trip the reader's continuity. They apparently voice the author's opinions, based upon his own experiences, and they move like flowing oil, so beautifully are they expressed.

The all too brief index, characteristic of British publications, decreases the reference value of the book; many desired and essential entries are missing. The bibliographies would be more valuable if they included the initials of the authors and the titles of the articles.

One who undertakes the difficult task of reading, evaluating, selecting, organizing, and discussing the ophthalmic literature of the world deserves the highest praise. Commendations due to the innumerable excellent features of this volume would fill many pages, whereas all of the criticisms can be completed in a brief review. The book is a treasure and we should all be forever grateful to Sir Stewart Duke-Elder for its creation.

FRANK PAYNE

New York City



Frustration: The Study of Behavior without a Goal. Norman R. F. Maier. New York: McGraw-Hill, 1949. 264 pp. $3.50.

Prof. Maier has written a significant and exciting book. This is not to say that his book has "all the answers" or that this reviewer necessarily agrees with such putative answers as are given. But it raises the right problems, and the attempted solutions—whether right or wrong—are original and challenging.

Quite aside from its special content, this book is noteworthy for the fact that it is written by a man who, though primarily an experimental psychologist, is here concerned with clinical issues. The approach to these issues is sympathetic and by no means unsophisticated. The book is, indeed, a kind of model, both in terms of its objectives and its methods, for indicating how experimental and clinical psychology can interact, to the benefit and enrichment of both.

The author has picked out for major consideration what the reviewer regards as the absolutely central and most critical issue in clinical theory no less than in practice: It is the question as to why so-called neurotic behavior is at one and the same time *self-defeating and yet self-perpetuating,* instead of self-eliminating. This is the dilemma that prompted some of Freud's most brilliant speculations; and it is an issue which every serious student in the field must face. Maier attempts to deal with it as follows.

In ordinary trial-and-error learning, says the author, new responses are acquired or old ones eliminated on the basis of their consequences. But in other instances, responses persist despite continuously unfavorable consequences. Such an instance Maier and his students have been able to produce experimentally in rats by exposing them to discrimination problems, on a Lashley jumping stand, which are "insoluble." If the problem is soluble, the rats learn to jump to the right or the left on any given trial, according to the nature of the cue stimuli presented on that trial. But if the problem is insoluble, the rats tend to fall into rigidly fixed patterns, such as always jumping to the same side.

Maier uses this finding as a basis for postulating that under conditions of frustration there is often a breakdown of normal learning and the development of abnormal fixation. He thus evolves what might be called the *frustration-fixation hypothesis.* He rejects the Freudian hypothesis that fixated, or "symptomatic," behavior "may serve as a relief for the patient," in favor of the view that once the frustration-fixation mechanism has taken over, the usual principles governing adaptive behavior cease to operate and one sees the occurrence of "behavior without a goal."

The reviewer does not believe that this analysis is satisfactory (cf. Freud's equally *ad hoc* and circular concept, the "repetition compulsion"), but the author does a skillful job of illustrating and defending his thesis, which he states boldly and lucidly.

To many readers the most illuminating part of the book will be chapter 8, in which the author brings his earlier experimental work on reasoning to bear upon contemporary problems in the field of counseling and psychotherapy. Although he largely follows Rogers' analysis of the treatment process, clinical workers of other persuasions will find Maier's discussion of "reasoning as the combination of elements in experience that have not previously been combined" highly suggestive. This part of the book leads to a consideration of some of the most basic issues in the entire field of personality and behavior theory.

O. HOBART MOWRER

University of Illinois

Studies in Population: Proceedings of the Annual Meeting of the Population Association of America at Princeton, New Jersey, May 1949. George F. Mair, Ed. Princeton, N. J.: Princeton Univ. Press, 1949. 169 pp. $2.50.

This publication is described as "an experiment" in that it for the first time presents the collected proceedings of an annual meeting of the Population Association of America. It includes so much useful material that it is almost certain to be given a wide welcome and, it is to be hoped, continuation.

There are five sections: Application of Demographic Data to Current Problems; Tools for Demographic Research; Resources for the World's People; Value Systems and Human Fertility; and Future Course of Research in Fertility. A wide gamut of problems is considered, and sections III and IV, which had been presented more or less as organized symposia, are the subjects of penetrating evaluations by Warren S. Thompson and Kingsley Davis. Space permits only the briefest comment on a few papers.

Many will find most interest and significance in one contribution that, in a sense, does not belong here at all: "The Catholic Value System in Relation to Human Fertility," by the Rev. William J. Gibbons, S.J. Its

premises are frankly "supernatural" and therefore not susceptible of scientific examination; one believes them, or one doesn't. Yet it has scientific importance for the cultural anthropologist, and especially for the sociologist and medical man, who constantly meet defeat, through the political pressures exerted by the group Fr. Gibbons represents, as they attempt to solve some of the world's most critical problems by a rational approach to population control. Here is warfare of theology against science, on a level affecting the earthly lives of millions of people. What it may be doing to their lives in the next world, I do not consider myself competent to judge.

The discussion of resources by Profs. Black of Harvard and Bradfield of Cornell contains a great deal of useful material and sharpens their criticisms of a number of recent writers who have expressed concern over rapid population increases and reckless destruction of resources. It is unfortunate, it seems to me, that they elected to devote nearly all their attention to food, instead of looking at the total environments in which the food must be produced. Every physical environment consists of an extremely complex, four-dimensional system of dependent variables upon which is imposed a powerful human cultural complex that may include factors as deadly as any lethal gene. Until we begin to organize our thinking in such terms, it is going to be extremely difficult to understand that what is possible at Beltsville may be impossible for many decades in the so-called backward areas, plagued by exploding populations. Dr. Thompson, in his discussion, brings the problem into focus in more of its complexity.

One more point should be noted: a popular estimate of potential agricultural land is uncritically cited (p. 74). Many people consider this too high; E. S. Archibald, director of the Experimental Farms Service, Dominion of Canada, on a recent CBC broadcast, characterized the estimate of 300 million available acres of northern podsol as "fantastic," based on his experience in Canada. I should apply the same word to one billion acres of potential tropical agricultural land, based not on what American soils scientists *might* do with the land, but on what the people of the tropics are doing *to* it, and are likely to continue doing for decades.

WILLIAM VOGT

Washington, D. C.

Theory of Hearing. Ernest Glen Wever. New York: John Wiley; London: Chapman & Hall, 1949. 484 pp. $6.00.

Professor Wever's book is an important one for a variety of reasons. As a general source of information on theories of hearing it has no equal in English. The reader, whether expert or naive, will find here adequate summaries of old and new ideas on how we hear, and if he wishes to pursue these matters further, the bibliography will point the way.

A lucid synopsis of the present state of our knowledge on both cochlear anatomy and acoustic neurology is presented. The author shows how advances in understanding have followed "accretion to anatomical knowledge," and he describes for the first time certain of his own measurements on the cochlea of man. In view of this emphasis on anatomy it is strange to find no mention of the acoustic projection to the cerebellum which was convincingly demonstrated some eight years ago.

The author's current concept of the volley theory is expounded in detail, and experimental evidence of many kinds is impressively marshaled in its support. His selection of material from the literature of physiology and psychology, and his willingness, throughout, to take a positive stand on controversial matters will provide considerable stimulation for the initiated among his readers.

In this readable and scholarly work, the substantial advances of the past twenty years march past in orderly fashion. They are reviewed by one of the most prolific workers in the field, who makes here still another contribution to it. As seen through his eyes—and the expanded version of his views of auditory theory is well worth having—"The place and frequency principles have been assigned their respective roles as well as may be on a basis of the evidence now at hand, . . . and it will remain for further experimentation and discussion to determine how reasonable they are and to work out the revisions, large and small, that are found to be necessary."

ROBERT GALAMBOS

Harvard University

Adaptation. John Romano, Ed. Ithaca, N. Y.: Cornell Univ. Press, 1949. 113 pp. $2.00.

In dedicating a new department of psychiatry at Strong Memorial Hospital, University of Rochester, Dr. Romano, the psychiatrist-in-chief, called upon a group of distinguished scientists representing biology, physiology, psychology, psychiatry, and social anthropology to participate in a symposium on the general topic of adaptation. This book is a collection of their presentations.

Dr. Romano's modest hope was that with psychiatry setting the stage, his guests might, by a few well-chosen observations from their own special fields, help bridge the gap in scientific thinking between the physical and the social sciences. The present pocket-size volume thus offers a surprisingly rich fare of stimulating comments on the phenomena of adaptation to life on various levels from the protoplasmic molecule to group cultures.

The concept of adaptation is almost as immanent and provocative as was the subject of Rochester's earlier symposium on man's behavior, where love was summed up as the harmony of man with himself and with all things in heaven and earth. On this occasion the treatment is somewhat less speculative. In five concise interpretations it is shown that from the lowliest of bacteria to the highest of animals, individuals and social groups maintain their integrity against the stresses of the world by following the same general principles of change in structure or in pattern of behavior to achieve long or short term adaptations.

In his introduction, Dr. Romano states that modern psychiatry has the responsibility to provide firm ground, especially in methodology, for the development of the social sciences, much as physics and chemistry provide for the biological sciences. Application of strictly scientific methods to such urgent but sensitive problems as infant and

child care, sexual behavior, and family and group situations in school, work, play and worship may, Dr. Romano admits, result in what he mildly terms anxieties and unrest. Fortunately, as a true scientist, he seems willing to let the chips fall where they may, in spite of the dilemma his facts pose—that more psychiatrically gifted clinicians are needed but the funds to support their training must often be obtained from wealth in the hands of the unintelligent and emotional.

The collection is opened with a scholarly presentation by Paul Weiss on "The Biological Basis of Adaptation." He reminds us that throughout evolution the fundamental features of life are the same. There are the same general molecular arrangements, the same methods of energy transfer and biosynthesis, the same mechanisms of growth and activity—all prototypes of mutual adaptedness, of harmony with conditions at every level from the subprotoplasmic world of the enzyme and substrate to the level of the central nervous system, from the molecular ecology of the cell to the group ecology of populations. Pervading all, the one common prerequisite for survival is simple fitness and harmony. And although fitness in general appears to be wholly dependent on the slow process of evolutionary screening, it is comforting to be assured that perfection and precision of fitness can still be achieved by direct on-the-spot adjustments under control of the individual organism. Considering the immensely greater powers for such direct adjustive action given to the human brain as compared to other organic systems, the reviewer agrees with Dr. Weiss that increased wisdom in the use of its powers is our challenge and opportunity.

Homer Smith of New York University discusses "Organism and the Environment." He quotes the familiar "we must view with profound respect the infinite capacity of the human mind to resist the introduction of knowledge" to emphasize that brain cells are intrinsically conservative, that new cortical pathways are acquired only by destroying or inhibiting the old, and that all physiological reactions are simply reactions against disturbance in an attempt to restore protoplasmic comfort. As a physiologist, Dr. Smith sees no reason to look outside demonstrable protoplasmic reactions in order to interpret even the most complex of the functions of the central nervous system. We wish the speaker had stopped there and had not attempted to tackle esoteric questions of religion, theology, and prayer, especially in connection with opinion poll methods. For many scientists of moderately sound insight the prayer "Thy Kingdom come . . . on earth" can hardly be dismissed as a mere unintelligent petition for miraculous intervention. Nor do all scientists agree that man's theological gropings have been his greatest handicap to advance in stature and in ability to live with his fellows.

Speaking for the psychologists, Dr. Liddell of Cornell discusses "Adaptation and Intelligence." Tracing the development of psychosomatic medicine, he reviews many of the early findings on conditioned reflexes in the light of more recent studies on experimentally induced neuroses. The animal ancestry of psychopathological phenomena interests him, although he emphatically denies that any serious investigator would actually identify the experimental neuroses in the mammal with the neurotic process in man. Dr. Liddell's modest conclusion is that workers in the field of animal behavior feel they are contributing to a common cause, with psychiatrists and other interested scientists, in directing more light on the problem of man's behavior.

Lawrence Kubie's discourse on "The Neurotic Potential and Human Adaptation" is refreshingly lucid and pertinent. In developing the case for the neurotic, Dr. Kubie reminds us that under favorable circumstances even neurotic mechanisms may be used to drive activities that are useful and creative. And he emphasizes that, given a change in external situations, an apparently well-adapted but actually neurotic personality may suffer what may seem an inexplicable collapse. The ability to recognize neurotic indications fits in with the whole story of adaptation, for such ability rests on an appreciation of the determining factors in all behavior.

Conduct based on conscious processes is flexible and realistic. Its motivations are influenced by appeals to reason and feeling. The individual has the capacity to learn from experience, and hence is free to grow in wisdom and understanding. His actions show personal responsibility, self-control, and productive enterprise. Behavior determined by unconscious processes, on the other hand, is rigid and inflexible. It cannot be altered by argument or reason, or even by its own success or failure. Since it recognizes no goal it is senselessly and endlessly repetitive. The individual learns nothing. He is enslaved. This kind of behavior is often characterized by extreme nationalism, group hatred, regimentation, and inertia.

As Dr. Kubie points out, there is, of course, no pure culture of one or the other dominant force, but a mixture is always at work in each of us. Where the conscious processes dominate, the behavior is normal and adaptive; where unconscious processes are allowed uninhibited sway, the personality is neurotic and unadaptive. The inescapable conclusion is that if we hope to shape human progress toward flexible and truly adapted living we must attempt in every way possible to extend the area of conscious and purposeful motivation.

The final paper in the collection is by Clyde Kluckhohn of Harvard on "The Limitations of Adaptation and Adjustment as Concepts for Understanding Cultural Behavior." Although Dr. Kluckhohn credits functionalist anthropology with giving the same light to group behavior as psychoanalysis has shed on individual conduct, he denies that cultural phenomena can be explained in terms of simple drives and needs. "Varieties of human temperament obfuscate the neat schemata of the functionalists." Furthermore, the relief-from-tension formula for motivation, he feels, is obviously inadequate, since tensions are frequently deliberately sought, and growth and creativity can come as much if not more from instability as from freedom from stress.

Mowrer's distinction between adaptation and adjustment is stressed. Adaptation is a survival of the fittest through natural selection, and adjustment a continuing

reaction to stimulation which persists as long as stimulus is present and forms a basis upon which habits are developed and modified. Dr. Kluckhohn feels that neglect of these distinctions has caused confusion and that their proper appreciation can materially aid in applying the methods of psychoanalysis, anthropology, and learning theory to a greater understanding or even an occasional prediction of human group behavior.

Unfortunately, culture change seems to involve a ceaseless flux of both internal and external factors, and cultures themselves have a tendency to create just about as many problems for the individual as they solve for him. Society as a whole has certain requirements referable primarily to the group rather than to the biologically derived needs of the individual; this reviewer concurs in the conclusion that in a well-considered plan of social study, culturally created values must be recognized as well as the external and immediately observable environment.

DANA COMAN

Department of the Army

Seismicity of the Earth and Associated Phenomena. B. Gutenberg and C. F. Richter. Princeton, N. J.: Princeton Univ. Press, 1949. 273 pp. $10.00.

The objectives stated by the authors of this text on earthquakes are: to evaluate the present relative seismicity of various parts of the earth and to discuss the geography and geological character of the zones and areas of seismic activity. In fulfilling these objectives the authors give the reader a broad summary of the results of a vast amount of geophysical research, particularly their own. Their subject matter and general presentation will appeal to the reader with a casual interest in earth science as well as to the specialists—geophysicists, geologists, and geographers.

The observational basis of the book is the great mass of data compiled from records of seismograph stations throughout the world. Data are more or less available for all significant earthquakes that have occurred since 1904. The authors have taken these data and (1) located epicenters, (2) determined the depth of focus, and (3) evaluated the magnitudes of hundreds of earthquakes. Their results are presented in 154 pages of tables headed as to depth of focus and geographic region of the earthquakes. These tables provide a convenient reference which should be useful in a variety of studies.

A large proportion of the text is devoted to a discussion of the regional distribution of epicenters and their relations to the larger units of geologic structure. The frequency and energy of earthquakes, the interior of the earth, the mechanics of earthquakes, and tsunamis (seismic sea waves) are treated in smaller sections.

Maps showing the regional distribution of epicenters and active volcanoes are numerous and well placed throughout the text and certainly these maps and the data upon which they are based should serve as a basis for the revision of older ideas which have fulfilled their purpose but often appear in new books on the earth.

In view of the importance of the earthquake magnitude scale and the energy computations made with it, it is unfortunate that the discussion of these subjects had to be so brief in the book. It seems that a few more remarks on these computations would have benefited those readers who will not have immediate access to the articles in the journals. One has the feeling that the exact significance of the energy ratios as determined by the authors may be overlooked by many who will see this work. There are several places in this section of the book where the wording is so concise as to detract from the clarity.

The authors explicitly state their intention "to present facts of observation with only a minimum of hypothesis," and one can note that care has been exercised in this regard. Here and there throughout the book, however, appear several of the authors' conclusions which, although some have previously been stated in scientific journals, will undoubtedly prompt discussion and the review of related evidence. Outstanding in this respect one might note the following conclusions: that the Pacific arcuate structures contain thrust planes which dip towards the continents; that the ground displacements in regions of block faulting are always in the same sense; that small shocks are never sufficiently frequent to approximate the energy released in larger shocks and therefore cannot function as a "safety valve" to delay a great earthquake; and that there is a thin "continental" crust under the Atlantic Ocean.

This is a book which conveys a great deal of factual information on earthquakes and enough of the authors' experienced interpretations to make stimulating reading.

ROSS R. HEINRICH

Saint Louis University

Electron Microscopy: Technique and Applications. Ralph W. G. Wyckoff. New York: Interscience, 1949. 248 pp. $5.00.

During the past five years Dr. Wyckoff and his colleagues at the National Institutes of Health have contributed significantly to the art of electron microscopy, particularly in the use of metal shadow-casting and surface replicas for the preparation of specimens. This nicely written book is a presentation of their results and contains brief descriptions of the methods used to obtain them.

The history, construction, and adjustment of electron microscopes, together with brief but helpful descriptions of various techniques for preparing specimens, take up only 80 pages. The remaining 58 pages of text describe the results—a selection of 175 of Dr. Wyckoff's superb electron micrographs of specimens ranging from metals and tooth structures to viruses and crystals of large molecules. The interpretation of the pictures is usually made independently of x-ray diffraction, sedimentation, or physiological studies of the material, and in some

cases is at variance with the results obtained by these methods. This tendency to consider the microscope as an independent tool of research is reflected by the fact that the thousand or so references are concerned exclusively with electron microscopy. The reader will have to refer to these references for further details of specimen preparations, although, to the reviewer's knowledge, Dr. Wyckoff has never described his methods in as great detail as he does in this book. It should, therefore, find a place in the library of every electron microscopist.

THOMAS F. ANDERSON

University of Pennsylvania

Freeze-Drying: Drying by Sublimation. Earl W. Flosdorf. New York: Reinhold, 1949. 280 pp. $5.00.

This timely little book is written for those who use and study the technique of drying from the frozen state as applied to a variety of experimental fields—micropathology, immunology, histology, pharmacology, and engineering. The author foresees that "probably few will read the book from cover to cover," but it is equally certain that many will find a wealth of information in it.

Particularly instructive is the chapter on "Basic Principles," with its good review of the bibliography. In "Applications" the author covers thoroughly the various aspects of the art, especially as applied to medicine. "Equipment for Food" is a very stimulating chapter, as it opens a hopeful view of things to come. Various portions of the historical review may appear somewhat one-sided, but the chapter dealing with equipment for medical products is a very clear and complete catalogue.

The competence of the author makes the publication a most desirable and practical reference book, completed as it is by an excellent index.

MAX M. STRUMIA

Bryn Mawr Hospital

Oscillations of the Earth's Atmosphere. M. V. Wilkes. New York: Cambridge Univ. Press, 1949. 76 pp. $2.50.

This book deals with the lunar and solar atmospheric tides. It summarizes observational facts and theory, and discusses the implications tidal theory has for the exploration of the high atmosphere. The semidiurnal solar tide was discovered not very long after the invention of the barometer, when the first observations were made at tropical latitudes; whereas lunar tidal effects, which are considerably smaller, were first found about the middle of the 19th century. It was early recognized that the smallness of the lunar tide as compared with the solar tide requires some special explanation because the tide-generating gravitational force of the moon is more than twice as large as that of the sun. Such an explanation was advanced by Lord Kelvin's "resonance" theory, according to which the semidiurnal variation of the air pressure is caused by the diurnal temperature variation. In the latter the diurnal term is, of course, much larger than the semidiurnal, but Kelvin suggested that the atmosphere has a free period in the vicinity of 12 hours so that even with small amplitude of the generating force the semidiurnal term in the pressure oscillation becomes much larger than the diurnal term. Early investigations by Pièrre de Laplace and later ones by Max Margules, Horace Lamb, and V. Bjerknes indicated that an autobarotropic atmosphere—that is, an atmosphere in which the law of compression and the actual density distribution are such that a displaced fluid particle assumes always the density of the environment—has a free period in close proximity to that required by the resonance theory, and that such oscillations can be discussed in terms of those of an equivalent ocean whose depth determines the length of the period of oscillation. However, since the atmosphere is not autobarotropic, it appeared that the "equivalent depth" of the atmosphere is too large and the period therefore too long to give the degree of resonance postulated by Kelvin, until Chaim Pekeris showed, following G. I. Taylor's work, that an atmosphere in which the temperature agreed with the observations up to 40 miles and did not contradict the indirect evidence then available for higher levels has a period of the required length. This work of Pekeris and subsequent investigations by the author of the book together with K. Weeks are dealt with at length in the book under review. An analogy to the theory of the propagation of electromagnetic waves permits an easy discussion of the possible trapping of energy when different types of vertical temperature distributions, analogous to different types of distribution of the refractive index in electromagnetic theory, are assumed. Such considerations of the trapping of the energy give valuable hints concerning the nature of the actual vertical temperature distribution that point toward oscillations with the period required by the resonance theory. The actual calculation of various temperature profiles gave free periods of a length required by the resonance theory. Thus this theory would seem well established, although there are still some minor problems and difficulties to be resolved, as discussed in the last chapter of the book.

Shortly after the appearance of the book, however, considerable doubt was thrown on these favorable results by two reports on research projects sponsored by the National Advisory Committee for Aeronautics—demonstrating again, if such demonstration is needed, the very rapid development of upper-air research. Z. Kopal, L. G. Jacchia and Pièrre Carrus at Massachusetts Institute of Technology have shown in a preliminary report that the resonance magnification becomes too small to support the resonance theory when more recently adopted vertical temperature profiles, such as that adopted by NACA or that based on V-2 flights, are substituted for the profiles used by Wilkes. Pekeris found that the equivalent depth increases indefinitely with the period in an atmosphere in whose top layer the temperature increases linearly with height. The reason for this is that in such a layer the energy continues to spread to higher elevations as the period is lengthened. Tides in an atmosphere with a top layer of vertically increasing temperature may thus differ markedly from tides in an atmosphere with an inversion or decreasing temperature at the top, which latter tides are analogous to those in an ocean of equivalent depth.

These very recent results leave the issue of the resonance theory again in doubt. Nevertheless Wilkes' book is a very well-written account of the atmospheric tidal problem, its empirical results, and its theory. The volume has been well and attractively printed, but it is to be regretted that its price could not have been set considerably lower.

B. HAURWITZ
New York University

Reviewed in Brief

Penicillin: Its Practical Application, 2nd ed. Sir Alexander Fleming. London, England: Butterworth; St. Louis, Mo.: C. V. Mosby, 1950. 491 pp. $7.00.

Only four years have passed since the publication of the first edition of this book. During this time many new antibiotics have been discovered and their virtues heralded. Penicillin, the first member of this group to be described, has unequivocally maintained its position as the best. The present volume is a complete revision and about 100 pages have been added, including four new chapters and two appendices discussing penicillin resistance and, very briefly, the data on aureomycin and chloramphenicol. Sir Alexander was aided in this task by some 33 colleagues, most of whom were active in the preparation of the first edition.

This new volume will be welcomed by the many workers who enjoyed the first edition.

Proceedings of the First Clinical ACTH Conference. John R. Mote, Ed. Philadelphia-Toronto: Blakiston Company, 1950. 607 pp. $5.50.

In the fall of 1946 a preparation of ACTH (adrenocorticotropic hormone) was made available for research on the properties of the hormone in man. During the succeeding two years the effect of stimulating the adrenal cortex with ACTH was studied in normal human beings and individuals with obvious endocrine defects by a number of investigators.

The contents of this volume constitute the proceedings of a conference held in Chicago on October 21 and 22, 1949 under the auspices of Armour and Company. The attendance was limited to those workers who had been actively engaged in these studies. There are 52 formal papers with the supplementary discussions. It is perfectly clear from a perusal of these contributions (in some instances only one patient was studied) that they represent merely progress reports. As such, they will be of inestimable value in the planning of future research.

Surface Tension and the Spreading of Liquids. 2nd ed. R. S. Burdon. New York: Cambridge Univ. Press, 1949. 92 pp. $2.50.

This is a remarkably fine treatment of the phenomenon of spreading of liquids over both solid and liquid surfaces. The author presents much of the pertinent literature, but concentrates on the theoretical aspects of the subject, and his analysis serves to show how rudimentary is our knowledge concerning even the forces which bring about spreading.

The present monograph is a second edition of this book, which originally appeared in 1940 in the Cambridge Physical Tracts series. Chapters 1 and 2 discuss the nature of surface forces and their measurement—a treatment that comprises the usual advanced textbook section on surface tension. Chapter 3, on the surface tension of mercury, is justified by the very considerable lack of agreement among observers as to what the value for the surface tension of Hg actually is. Chapters 4, 5, and 6 are devoted to a consideration of spreading on water and Hg. A number of the more obscure phenomena encountered in spreading studies are analyzed and indeed these chapters are the most useful ones for a reader with some previous knowledge of surface phenomena. Chapter 7 concludes with a consideration of spreading on solids (i.e., lubrication). Such phenomena, in spite of their obvious practical importance, are as poorly understood as spreading over liquids.

Medical Entomology. 2nd ed. Robert Matheson. Ithaca, N. Y.: Comstock Publ., 1950. 612 pp. $7.50.

The first edition of this well-known text appeared in 1932 and established at once a most enviable reputation. The global aspects of World War II brought millions of people into intimate contact with insects and evoked to a marked degree an appreciation for the role they play in the well-being of mankind. Not only do they transmit bacteria mechanically, as was so beautifully demonstrated for the house fly and typhoid fever during the Spanish American War, but they are hosts to such forms as the etiological agents of filariasis, a disease that threatened members of our armed forces stationed in certain areas of the Far East. The development of insecticides such as DDT and repellants of the phthalate series were outstanding war measures for the protection of troops. These investigations and many others carried out during and since the war have immeasurably advanced our knowledge of insects in relation to diseases of man and animals.

The second edition of *Medical Entomology* has been completely rewritten and contains data available to the end of 1948. The contents are arranged in somewhat the same manner as in the first edition and the final chapter gives simple directions for collecting and preserving insects. The text is recommended to the physician, the public health worker, the medical student, and the layman as an authoritative survey of our present knowledge.

Quantitative Ultramicroanalysis. Paul L. Kirk. New York: John Wiley; London: Chapman & Hall, 1950. 310 pp. $5.00.

The present volume is intended to summarize the current status of microgram procedures for analyses of all types that have been proved practical and to include the smaller-scale procedures of colorimetry that have been tested. The ten chapters are headed introduction, volumetric apparatus and technique, colorimetry: apparatus and technique, general apparatus and technique, microgram titrimetry, metallic constituents: titrimetric methods, nonmetallic constituents: titrimetric methods, volu-

metric gas methods, spectrophotometric methods, and physical methods. In the closing paragraphs the author points to the important of an understanding of the chemistry of the cell and injects the sibylline note that there are no insurmountable problems to prevent the ultimate chemical analysis of single cells.

The book is well written and is highly recommended to the teacher and student alike.

Scientific Book Register

Agriculture

Agricultural Chemistry, A Reference Text; Vol. I: ***Principles of Agricultural Chemistry.*** Donald E. H. Frear, Ed. New York: D. Van Nostrand, 1950. 812 pp. $9.00.

Advances in Agronomy, Vol. I. A. G. Norman, Ed. New York: Academic Press, 1949. 439 pp. $7.50.

Plant Disease Handbook. Cynthia Westcott. New York: D. Van Nostrand, 1950. 746 pp. $7.50.

Soils: Their Physics and Chemistry. A. N. Puri. New York: Reinhold, 1949. 550 pp. $7.00.

Biology

Traité de Zoologie: Anatomie, Systématique, Biologie: Oiseaux, Vol. XV. Paris VI^e: Masson et Cie, 1950. 1164 pp. 6000 fr.

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Vom Molekül zur Organismenwelt: Grundfragen der Modernen Biologie. 2nd rev. ed. Ludwig von Bertalanffy. Potsdam, Germany: Akademische Verlagsgesellschaft Athenaion, 1949. DM 6.60.

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Textbook of Physiology. 10th ed. William D. Zoethout and W. W. Tuttle. St. Louis, Mo.: C. V. Mosby, 1949. 710 pp. $4.75.

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Elastomers and Plastomers: General Theory, Vol. I. R. Houwink, Ed. New York-Amsterdam: Elsevier Publ., 1950. 495 pp. $7.00.

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Adaptation, John Romano, Ed. Reviewed by Dana Coman, p. 435.

Advances in Enzymology and Related Subjects of Biochemistry, F. F. Nord, Ed. Reviewed by C. B. Anfinsen, p. 419.

Albert Einstein: Philosopher-Scientist, Paul Arthur Schilpp, Ed. Reviewed by I. I. Rabi, p. 409.

Algebraic Curves, Robert J. Walker. Reviewed by Irvin S. Cohen, p. 415.

Alkaloids: Chemistry and Physiology, R. H. F. Manske and H. L. Holmes, Eds. Reviewed by Lyndon F. Small, p. 418.

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Antibiotics, George W. Irving, Jr. and Horace T. Herrick, Eds. Reviewed by H. E. Carter, p. 422.

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Atomic Energy Yearbook, John Tutin, Ed. Reviewed by R. D. Huntoon, p. 412.

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Constructive Uses of Atomic Energy, S. C. Rothmann, Ed. Reviewed by R. D. Huntoon, p. 412.

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Some Recent Researches in Solar Physics, F. Hoyle. Reviewed by D. ter Haar, p. 414.

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Surface Tension and the Spreading of Liquids, R. S. Burdon, p. 439.

Text-book of Ophthalmology: The Neurology of Vision, Motor and Optical Anomalies, W. Stewart Duke-Elder. Reviewed by Frank Payne, p. 433.

Theory of Hearing, Ernest Glen Wever. Reviewed by Robert Galambos, p. 435.

Theory of Probability, Hans Reichenbach. Reviewed by R. v. Mises, p. 415.

Titanium: Its Occurrence, Chemistry, and Technology, Jelks Barksdale. Reviewed by Therald Moeller, p. 418.

Unités Biologiques Douées de Continuité Génétique. Reviewed by Jack Schultz, p. 403.

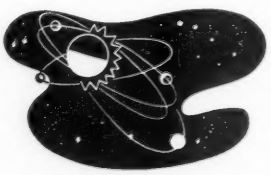
University Physics, Francis Weston Sears and Mark W. Zemansky. Reviewed by T. Enns, p. 413.

Vertebrate Body, Alfred Sherwood Romer. Reviewed by William O. Puckett, p. 423.

Vitamin Methods, Paul György, Ed. Reviewed by Mary S. Shorb, p. 422.

Water in the Physiology of Plants. A. S. Crafts, H. B. Currier, and C. R. Stocking. Reviewed by Donald B. Anderson, p. 427.

Webs in the Wind: The Habits of Web-weaving Spiders, Winifred Duncan. Reviewed by Edward A. Chapin, p. 425.



Comments and Communications

Incidence of Rh_o Negative Reactors among Chinese

In view of somewhat different results on Rh_o testing among groups of relatively small numbers of Chinese from various parts of the country (Hao, S. H. *Chinese nat. med. J.*, 1949, **35**, 101; and Pan, S. F. *Peking nat. Hist. Bull.*, 1949, **17**, 223) further efforts have now been made to extend our preliminary results by examination of a larger and representative sample here in Peking. Although the local population is largely of the Northern parentage, it includes a varied proportion of people from other parts of the country. Altogether 2,324 persons attending the various clinics of the Peiping Union Medical College Hospital, as well as a number of professional donors and newborn babies, have now been examined.

The slide method (Diamond, L. K. and Abelson, M. N. *J. clin. Med.*, 1945, **30**, 204) was used throughout the study, but in case of a negative reaction, the result obtained by the tube method (Wiener, A. S. *Amer. J. clin. Path.*, 1946, **16**, 477) was considered as final. In the present study, only 14 of 2,324 Chinese were found to be Rh_o negative reactors, or 0.6 percent. Incidentally, among an additional group of 67 Caucasians, 17, or 25 percent, gave negative reactions. Comparing this with the data previously published, we found our figure approached closely the average of 47 negative reactors among a total of 4,894 persons, or 0.94 percent. However, it must be mentioned that previous findings seemed to have indicated the possibility of intraracial difference in the incidence of Rh_o negative reactors among Chinese. For instance, the incidence of Rh_o among the Kweichow Chinese was found to be 2.9 percent, and among the Shantung Chinese, only 0.4 percent. The significance of this difference, however, must await further study of larger individual samples.

SYLVIA F. PAN

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Peking, China

On the Application of Harmonic Analysis to Ocean Wave Research

In a recent article (*Science*, 1949, **109**, 271) it has been suggested that Wiener's generalized harmonic analysis can shed new light on ocean wave research. The writers of that paper, H. R. Seiwell and G. P. Wadsworth, assume that a storm generates a dynamic component (swell) on which is superposed a random variation due to "random motions of the water and local intermittent wind action." It is their aim to separate these components in continuous records of dynamic wave pressure, and it is claimed that they can "eliminate the objectionable a priori assumptions of Fourier series applications to geophysical time series, and obtain results of dynamic significance." However, objections can be raised against their method. It appears to us that the correlogram and the Fourier series suffer from the same difficulty, namely, that both are ill defined. The definition of the spectrum requires an infinite record, which is not available in geophysical applications; the record is in fact of limited duration and in the absence of information we are at liberty to continue it in either direction in any "reasonable" way we fancy and to each continuation there corresponds a different Fourier integral spectrum.

Mathematically, each of these gives a perfect resolution of the available information and only a physical model can make us prefer one resolution (say into discrete Fourier harmonics) to another (say the frequencies defined by the transcendental equation $k \tan k = a > 0$). These remarks are clearly applicable to the correlogram also. Nevertheless, the different resolutions have certain averages in common (Barber, N. F. and Ursell, F. *Philos. Trans. roy. Soc. Lond.*, 1948, 554) but it is clear that the introduction (which is physically reasonable) of random components into a finite record will lead to enormously greater uncertainty, and a much more detailed physical model is accordingly required to interpret the result of the analysis.

Seiwell and Wadsworth therefore make the additional assumption that the swell component consists of just one sine wave, and it is this assumption in particular that we wish to challenge. A large number of Fourier analyses of pressure records have been made at the Admiralty Research Laboratory, Teddington, England, and interpreted according to a model of the following type:

Ignore all random effects. Consider an instantaneous local impulse applied to the surface of a perfect fluid of infinite depth. Cauchy and Poisson showed over a century ago that the elevation η at a distance R from, and at time t after, the impulse is given by

$$\eta = H(R,t) \sin \left(\frac{gt^2}{4R} + \varepsilon\right),$$

where $H(R,t)$ changes much more slowly with time than the sine factor (Lamb, Sir H. *Hydrodynamics*. 6th ed. Cambridge, 1932). Over an interval corresponding to the usual 20-min wave record the pressure fluctuation would be practically a single sine wave with the frequency predicted by considerations of group velocity (Barber, N. F. and Ursell, F. *Philos. Trans. roy. Soc. Lond.*, 1948, 527) but when we consider a series of impulses distributed over a finite area and continuing over a finite time we are led naturally to the conception of a continuous spectrum, each element of which can be traced back by the group velocity method into the area of wave generation. It is known that this result is largely independent of the method of generation, provided that the area of generation is well defined and not too near the recorder. It is also clear that when a storm arises suddenly, the records will show a widening spectrum. It has been checked experimentally that it is indeed possible to separate swell from different storms

and to trace the components back by the group velocity method. A series of typical spectra is shown in Fig. 1.

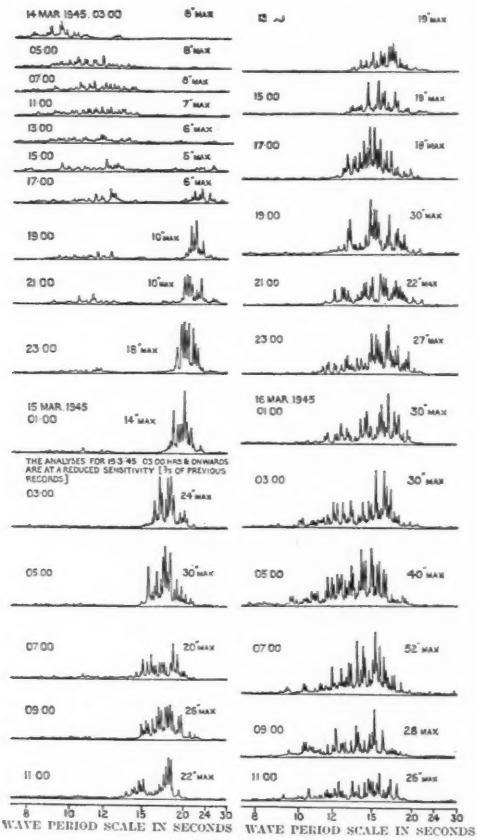

FIG. 1. A series of wave spectra obtained by analyzing wave records made on the coast of Cornwall. The first indication of the longest swell (period 24 sec) from a storm 600 miles southeast of Newfoundland appears at 13.00 March 14. Subsequent spectra show a decrease in the mean period and broadening of the wave band in agreement with theory. The analysis corresponds closely to a resolution into Fourier harmonics and is not unique.

Thus it appears to us that the continuous character of the spectrum of swell is well established.

The analysis of record 53-X in Seiwell and Wadsworth's *Science* article further strengthens this view. For they find that the period of swell component and the principal period of the supposed random component are both 12.25 sec. The fundamental assumption that the two components are independent therefore looks very dubious. We conclude that the consideration of random components will not lead to useful results until reasonable assumptions are made about the behavior of swells but we are convinced that the assumption of a single sine wave for the undisturbed swell is not adequate.

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The questions raised by Mr. Ursell will be discussed in a paper to be published soon in *Science*.

The object of analyzing ocean wave records is to discover the fundamental laws by which they are generated. These data are finite in scope, and any system of mathematics developed for infinite series, although safe for the problem for which it was developed, may become unsafe for application to ocean wave analysis.

The problem of treating data as presented by nature requires an experimental approach, such as may be had by study of artificially generated mathematical models of finite scope. In a series of such experiments undertaken in this laboratory, it has been indicated that the method of autocorrelation analysis provides more information than does that of periodogram or Fourier series analysis. The latter method in particular, when applied to finite data, may indicate spurious teeth or peaks leading to illusions of periods in the basic data. Several examples are discussed in the forthcoming paper.

Our comparisons of the two methods of analysis have revealed results in agreement with those put forward by the British statistician, Maurice Kendall (*National Institute of Economic and Social Research*. Occasional Papers IX, 1946). The latter method, although dealing primarily with economic times series, has produced results directly applicable to the problem of Mr. Ursell.

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News and Notes

The National Convention of the Institute of Radio Engineers

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Bell Telephone Laboratories, Murray Hill, New Jersey

The National Convention of the Institute of Radio Engineers was held in New York City March 6–9. A registered attendance of 18,000 was reported, and the number (163) and variety of the papers were almost equally overwhelming.

In addition to its technical aspects, this annual meeting provides an occasion for honoring men who have contributed to the radio art. This year F. E. Terman, dean of the School of Engineering at Stanford, was awarded the Medal of Honor; Otto H. Schade of RCA received the Morris Liebman Memorial Prize; the Browder J. Thompson Memorial Award went to Joseph F. Hull and Arthur W. Randals of Evans Signal Corps Engineering Laboratory; the Harry Diamond Award to Andrew V. Haeff of the Naval Research Laboratory, and the Editor's Award to E. J. Barlow of the Sperry Gyroscope Company. In addition, thirty were made fellows of the institute.

The technical program of the convention clearly indicated the wide range of interest of radio engineers. Papers on industrial design emphasized links between purely circuit and performance considerations, mechanical design and manufacturing methods and their relation to cost, and the attitude and demands of style-conscious customers.

Papers on statistical methods, on acoustics, on audio quality and on television quality showed a deep current interest in the valid evaluation of the relation between the numbers read on meters and the reactions of human beings. In more narrowly technical fields, the papers on communication theory also showed the present effort to grasp the basic over-all human and engineering problems in transmitting speech and other information, as opposed to purely circuit aspects of the radio art.

In the realm of particular communication systems, television of course received most attention. At an evening symposium, the color problem was thoroughly aired with considerable illumination and contrast. In another aspect of television, a new pickup tube, the vidicon, represents an important stride toward the industrial use of that art.

Microwave radio relay systems, which can be used for television and for telephony, also received considerable attention.

Papers in the general field of electromagnetic waves and propagation show how much can still be done in these old fields so many years after Maxwell and Hertz. Papers dealt with broad-band antennas, artificial dielectrics, propagation along helices, along wires with a dielectric coating (this received even more attention in the newspapers than at the convention) and in a curved ionosphere. In the field of networks, emphasis was on transient behavior or the "time domain" (as opposed to the frequency spectrum), in keeping with current interest in television and in various pulsed microwave systems.

Among components, electron tubes are perhaps most versatile. After hearing about tubes to store binary digits and tubes to add and multiply them, tubes to produce special wave forms, 10-megawatt klystrons, and various others, one feels that electronics has reached a state in which a tube can be invented to do almost anything, once the goal is clearly set. In comparison, the newer art of solid-state devices, and especially of transistors, was seen in its lusty infancy.

Other components and circuits too numerous to mention showed the scope and detail of the radio engineer's art, and this was physically exhibited in the numerous manufacturers' displays.

In addition, there were sessions on digital computers, nuclear science, and medical electronics.

The 37th Annual Meeting of the International Council for the Exploration of the Sea

William F. Royce

Fish and Wildlife Service, United States Department of the Interior, Woods Hole, Massachusetts

The International Council for the Exploration of the Sea held its 37th annual meeting from October 3 to 11, 1949, at Edinburgh, Scotland.

This organization, concerned with the field of fisheries and the interrelated studies of the ocean, is truly international and has demonstrated for a period of years—stretching through two world wars—that it is possible to achieve sound and enduring international cooperation. The fishing fleets of northwestern Europe mingle on the fishing grounds and land in each other's ports. The fishermen and the fishing industries of the various nations share common problems. The fluctuations in the runs of herring and cod and the overfishing of the plaice are problems of immediate concern to the fishermen of at least seven nations. Fishing rights have been the source of endless arguments and even wars throughout recorded history. Today they are the cause of many international and local disagreements.

The settlement of these differences and the adoption of measures designed to promote sound conservation of the heavily exploited stocks of fish require an adequate basis of scientific knowledge. To provide this basis, Denmark, Germany, England and Scotland, Finland, the Netherlands, Norway, Russia, and Sweden formed in 1902 the International Council for the Exploration of the Sea. Subsequently, Belgium, Eire, Iceland, Poland, Portugal, and Spain became members. Poland failed to attend the 1949 meetings, and Russia and Germany have dropped out. Germany, however, was a member during the interval between the two wars, and Italy and Latvia were members for a short time.

The announced aim of the council at its inception was to prepare for a rational exploitation of the sea on a scientific basis. This was to be achieved by coordinating the meager scientific resources available and by effecting a free and rapid interchange of information between nations. The council has furthered this aim by annual and special meetings (which have been interrupted only by two world wars) and by providing an outlet for publications. The series of publications inaugurated by the council, *Rapports et Proces-Verbeaux, Journal du Conseil, Annales Biologique, Bulletin Hydrographique,* and *Bulletin Statistique,* are the most valuable journals in marine fisheries.

The principal studies encouraged by the organization included two fundamental lines of research: first, the investigation of the hydrographical conditions, and second, the biological conditions of the seas off Europe from Novaya Zembia to Greenland, and from the Arctic to North Africa. A third objective was to determine whether the catch of fish was greater than the natural production, i.e., whether there was overfishing.

The recent meetings held at Edinburgh, Scotland were attended by over 100 delegates and experts from the member countries and by observers and guests from Australia, Union of South Africa, India, China, the United States, and the Food and Agriculture Organization of the United Nations. These people deliberated in an atmosphere of the greatest courtesy and friendliness, despite the fact that many of the things they had to say concerned fisheries or areas for which their individual countries are economic rivals.

Especially significant were the reports on herring. This immense fishery, which is a major source of protein food for much of Europe, has been the subject of considerable study but still is little understood. An insight, however, is being gained into the factors that govern this fishery through new tagging techniques. Einar Lea of Norway reported on a new tag which can be succesfully attached to the outside of the delicate herring. Another interesting adaptation was the experimental use of magnetic internal tags which were recovered by magnets in the reduction lines of the fish meal plants. The few returns obtained from these experiments indicated that the herring migrated from Iceland to Norway and vice versa. This knowledge, in turn, induced the Norwegians to equip an expedition to search for the herring along their probable migratory route.

The warming of the Arctic seas of Spitzbergen was the subject of another intensive study. It was reported that an increase in the mean annual air temperatures of about 10° F over a period of two decades had been found at some weather stations. At the present time, the temperatures are decreasing and fears were expressed that the advance of the Arctic ice to the south might seriously affect the great cod fishery. To further substantiate these fears, the Norwegians showed that the Spitzbergen cod were of the same stock as the ones off the Lofoten Islands near Norway, and records of the Lofoten fishery, extending back nearly 1,000 years, showed a definite cycle with a period of 100 years.

If the decline in temperatures means that the cod are waning, it will have a serious effect on the British and others who have built great fleets of trawlers to fish for them. The U. S. fishery may be affected, too, because these trawlers, which are now fishing in the Arctic, have range enough to fish on the Newfoundland banks.

The recent studies made of the bottom fisheries of the North Sea have been concerned principally with the effect the last war, with its consequent cessation of fishing, has had on the fish stocks. The Scotch and English scientists concentrated their studies mostly on the haddock, hake, and plaice, which constitute the most important bottom fisheries. The great progress they made in assessing the causes of fluctuation has enabled them to make convincing predictions of the expected catch. Their analyses show clearly that, in some instances, less fishing would produce a greater tonnage of fish.

In the North Sea the need for conservation has been apparent for many years. Indeed, the situation is referred to as the tragedy of the North Sea. Scientists are agreed on this estimate, but getting the politicians of the several countries to agree on restrictions is a very different matter. This is illustrated by the most recent Overfishing Convention, signed in London in April, 1946, and reported on at the Edinburgh meetings of the council. It has been ratified only by Denmark, Netherlands, Norway, Poland, Portugal, Sweden, and the United Kingdom. France and Belgium had signed the treaty but had failed to ratify it. It was reported that, in an attempt to bring the treaty into operation, the United Kingdom was proceeding to ask the countries which had signed it if they would bring it into operation among themselves.

Outside of the North Sea area, increased production of fish and shellfish was the major objective of exploration and research. The French, Spanish, and Portugese reported extensively on studies of tuna and pilchards, and the Dutch and English, at a special committee meeting on shellfish, presented several papers on the culture, the purification, and the pests of oysters and mussels.

One of the most promising new instruments for locating fish and studying their behavior is the echo sounder. British scientists reported that they had learned to distinguish the echoes from schools of sprats, herring, mackerel, cod, tuna, and others. The instruments were used also to study the behavior of the fish in relation to the effects of daylight, of searchlights on the water at night, of engine noises, and of changes in the tide. They

also had been able to detect trawl nets with the sounder and to measure the heights of different parts of the net while fishing.

An important result of these meetings was the free discussion of both the current work and the plans for future work. One phase of the planning for future work concerned the efforts to coordinate the operations of the research ships of several member nations. Some of the vessel operations planned for 1950 were to be joint explorations for herring by the British, Norwegians, and Icelanders; comparison of French and British trawling gear in order to standardize statistical units of fishing effort; and studies of plaice by the Dutch and British.

No lesser coordination was apparent in the relations of the council with other international organizations. The Food and Agriculture Organization of the United Nations had just met at The Hague and these meetings had been attended by many members of the International Council. A favorable report was given on the activities engaged in by the FAO. Further interorganizational coordination was noted when the council discussed the Northwest Atlantic Conference which was held in Washington in January and February of 1949. This is an organization similar to the International Council, with jurisdiction over an adjoining area. The discussion entailed the possible overlapping of areas off Greenland, and was clarified at that time.

The spirit of cooperation which was evident throughout this meeting is a reason for the success of this organization, which will celebrate its 50th anniversary in 1952. The president of the council, K. A. Andersson of Sweden, remarked at the closing session that "We regard ourselves as a body which might be called a United Nations in miniature. . . . We regard ourselves as a brotherhood pledged to pool our scientific knowledge for the common benefit of our fellow man." This is the philosophy by which this singular international organization has survived.

American Chemical Society's 117th Meeting—Houston Session

James H. Stack

American Chemical Society News Service
New York City

Discovery of a new group of B vitamins, progress in the chemical study of pernicious anemia, and the development of improved synthetic lubricating oils were among the advances reported at the opening session of the American Chemical Society's 117th national meeting, held in Houston, Texas, March 26–30.

Two thousand chemists and chemical engineers participated in the session, the first of three into which the society divided its spring national meeting this year. The other sessions were scheduled for Philadelphia, April 9–13, and Detroit, April 16–21.

Four scientists were honored at a general assembly of the society on March 28. Kenneth S. Pitzer, of Washington, D. C., director of research of the Atomic Energy Commission, received the $1,000 Precision Scientific Company Award in Petroleum Chemistry. The $3,000 Ipatieff Prize for achievement in the fields of catalysis and high pressure was presented to Herman E. Ries, Jr., of the Sinclair Refining Company Research Laboratories, Harvey, Illinois. To William Shive of the University of Texas went the $1,000 Eli Lilly and Company Award in Biological Chemistry. The fourth prize, the $1,000 Fisher Award in Analytical Chemistry, was given to I. M. Kolthoff, of the University of Minnesota.

The new B vitamin group was announced by Prof. Shive in his Eli Lilly Award address. The vitamins have been named the folinic acid group and are directly related to folic acid, which they may replace in the treatment of sprue and both nutritional and pernicious anemia, Prof. Shive said. Microbiological tests indicate that the group, of which five members have been isolated, can be utilized more effectively than folic acid by most organisms—sometimes as much as 1,000 times more effectively—he reported. No clinical investigations have been made to date. Prof. Shive spoke at a symposium on pernicious anemia.

Viruses five times purer than any ever before obtained have been extracted from chicken cancer by means of chromatography, Vernon Riley, Mark W. Woods, and Dean Burk of the National Cancer Institute, Bethesda, Maryland, reported. This is the first time viruses have been purified by chromatography, according to the paper, which said that the technique is expected to facilitate greatly the study of virus activity in cancer and other diseases.

A new high quality synthetic lubricant which can meet the nation's needs when the premium oils now obtained from Pennsylvania and the mid-continent states are exhausted was described at a symposium on synthetic lubricating oils. The new product, made from abundant raw materials such as coal, oil shale, and refinery by-products, possesses quality standards not obtainable from petroleum oil without elaborate processing, according to F. M. Seger of the Socony-Vacuum Oil Company, Paulsboro, New Jersey.

New chemical products from petroleum and natural gas, the history and prospects of the American sulfur industry, and the 1950 employment outlook for chemists and chemical engineers were among the other subjects discussed in a total of 249 technical papers.

Allen G. Shenstone, Princeton physicist, was elected to the Royal Society of London on March 16. Dr. Shenstone is distinguished for his spectroscopic researches.

Louis Mars, dean of the Faculty of Medicine of Port-au-Prince, has been named a correspondent member of the Academy of Medicine of New York. The son of Haiti's leading ethnologist, Price-Mars, Louis Mars has for years been interested in the problems of comparative psychiatry.

Otis Dermer has been appointed head of the Department of Chemistry at Oklahoma Agricultural and Mechanical College, replacing **Otto M. Smith,** recently retired as professor emeritus. Dr. Smith has been appointed full-time director of the college's Research Foundation. Dr. Dermer has been head of the Organic Chemistry Division of the Chemistry Department since 1934.

Robert G. Helsel has been appointed professor of mathematics and chairman of the department at Ohio State University to succeed **Tibor Rado.** Dr. Helsel has been acting director of the department since October, 1949, when Dr. Rado was named as the first University Research Professor in the Graduate School.

Francis Drouet, curator of cryptogamic botany at Chicago Natural History Museum, will sail for Europe this month for a five-month study of collections of single-celled and few-celled algae in the principal museums. He will first go to the British Museum of Natural History in London, and from there to the principal museums of France, Switzerland, Austria, Italy, Germany, Holland, Denmark, Norway, and Sweden. While in Stockholm, Dr. Drouet will represent the museum in the Seventh International Botanical Congress (July 12–20).

Franklin A. Long has been appointed chairman of the Department of Chemistry at Cornell University, to succeed Peter Debye, chairman of the department since 1940, who will devote his full time to teaching and research. Dr. Long, a member of the faculty since 1937, has been active in investigations with radioactive tracers, and is Cornell's scientific representative on the board of trustees of Associated Universities, Inc., which administers Brookhaven National Laboratories.

Robert R. Shrock has been appointed head of the Department of Geology at Massachusetts Institute of Technology. A faculty member since 1937, Dr. Shrock has been executive officer of his department since 1946 and was appointed acting chairman upon the retirement last year of **Warren J. Mead.**

Visitors to U. S.

Franz Petrack, mycologist at the Natural History Museum of Vienna, recently arrived in this country to continue his work on a monograph of the Ascomycetes at the Mycological Laboratory of the Bureau of Plant Industry, Beltsville, Maryland. He has been given a grant of $2,500 by the American Philosophical Society to aid in this work.

Bertil Lindblad, director of the Stockholm Observatory of Sweden and president of the International Astronomical Union, and **Benght Stromgren,** director of the Copenhagen Observatory and secretary-general of the union, were recent guests of the Smithsonian Institution, Washington, D. C. Dr. Lindblad lectured on "The Luminous Surface and Atmosphere of the Sun" at the institution on April 5.

Among recent visitors at the National Bureau of Standards were: **R. A. Fisher,** professor of genetics at Cambridge University; **A. W. Norris,** of the British Ceramic Association, Stoke-on-Trent, England; **Eugenio Riesz,** of the Faculty of Humanities and Sciences, University of Montevideo, Uruguay; **T. W. Whitaker,** principal scientific officer, Building Research Board, Department of Scientific and Industrial Research, United Kingdom; **M. A. Arnan,** director of the Standards Institution of Israel, Tel Aviv, Israel; **D. I. Cameron,** research metallurgist, Lysaghts Newcastle Works, Tirrikiba, Australia; **John D. Flambouriaris,** professor at the National Technical University, Athens, Greece; **Johan Arvid Hedvall,** director of the Institute for Silicate-Chemistry Research, Goteborg, Sweden; **H. T. Roper-Hall,** president-elect of the British Dental Association, London; and **H. Tabor,** head of the Instrument Division of the Research Council of England.

Fellowships and Prizes

Two full-time, $2,000 research fellowships in pediatric allergy are offered by the Pediatric and Immunology Departments of New York Medical College. One will begin July 1, 1950, the other January 1, 1951. The fellowships will run from one to two years and will consist of intensive training in immunology and animal research in the field of hypersensitiveness and intensive study of allergic children. Applicants must be certified in pediatrics and those who have had training in chemistry or immunology will have preference. Applications should be made to the Office of the Dean, New York Medical College, 106th Street and Fifth Avenue, New York City.

The New York Zoological Society announces the availability of a summer fellowship for a graduate veterinarian, for work in the Zoo's animal hospital. The stipend is $500 for three months—June 15 to September 15. Veterinarians with degrees from approved colleges and with special interest in such fields as zoology, wildlife management, comparative anatomy, physiology, bacteriology, parasitology, and pathology may apply to Leonard J. Goss, New York Zoological Society, Zoological Park, New York City.

The Agricultural and Mechanical College of Texas' Department of Oceanography announces the **Dow Research Fellowship in Chemical Oceanography** for 1950–51, sponsored by the Dow Chemical Company. Appointment is on a 12-month basis with a stipend of $1,500 and an additional $500 for supplies, travel, and other items. Candidates are expected to qualify ultimately for a Ph.D. degree and should have completed a year or more of graduate

work in basic chemistry. Applications must be made by *May 15*. Application forms and additional information may be obtained by writing to the Head, Department of Oceanography, College Station, Texas.

The Edward L. Bernays Foundation Radio-Television Award for 1950, a $1,000 U. S. Government bond, will be presented by the American Sociological Society to the individual or group contributing the best piece of research on the effects of radio or television on American society. The award will be made at the meeting of the society in Denver, Colorado, in September. Those wishing to compete must submit in duplicate a report on the research *on or before July 1*. Any research study completed during 1948, 1949, or the first half of 1950 will be eligible for consideration. Both published and unpublished studies may be submitted, and even research not fully completed for which a preliminary report is available. Inquiries should be addressed to Clyde W. Hart, National Opinion Research Center, 4901 S. Ellis, Chicago 15, or to the Executive Officer of the American Sociological Society, 427 West 117th Street, New York City.

Summer Programs

The University of Colorado announces two five-week terms of **field instruction in biology** at Science Lodge, its mountain laboratory, June 17–July 21 and July 24–August 25. Kenneth Cooper, associate professor of biology, Princeton University, will be in charge of zoology instruction during the second term. Other members of the staff in biology will be Gordon Alexander and William Weber, both of the University of Colorado. Information about available field courses and the possibility of independent study may be obtained from Prof. Gordon Alexander, University of Colorado, Boulder.

The Political Science Department of the University of Michigan is offering a proseminar on public policy and atomic energy, to be given June 26–August 19 by Marshall Dimock, professor at the University of Chicago and Northwestern University. The course will consider such problems as the legislative formulation of policy, administrative operation of the program, coordination of military and civilian aspects of atomic energy policy, governmental relations with research institutions and business corporations, community management of atomic energy sites, towns, and regions, and international programs relating to atomic energy. The proseminar is part of the university's Phoenix Project, devoted particularly to research in atomic energy for peacetime uses. Inquiries should be addressed to the Secretary of the Summer Session, 3510 Administration Building, Ann Arbor, Michigan.

The Biological Laboratory at Cold Spring Harbor is offering a **summer course on bacteriophages**, June 26–July 15. The course will be given by Mark H. Adams, of New York University, and is designed to acquaint research workers with techniques used in work with bacterial viruses, and with recent results of such work. **A course on bacterial genetics** will also be given, July 17–August 5, by E. M. Witkin, V. Bryson, and M. Demerec, covering selected methods used in research in bacterial genetics. Information about either course may be obtained from the Biological Laboratory, Cold Spring Harbor, New York.

Meetings and Elections

The American Mathematical Society will hold meetings this month on the following dates: April 21–22, at Oak Ridge, Tennessee, in conjunction with a meeting of the **Biometric Society**; April 28–29, at Wheeler Hall, University of California at Berkeley; April 28–29, at the Government Building, George Washington University, Washington, D. C.; April 28–29, at Eckart Hall, University of Chicago, in conjunction with meetings of the **Institute of Mathematical Statistics.**

The fourth annual conference on mental hygiene and problems of exceptional children will be held May 12–13 at Syracuse University. The theme of the meeting will be "The Prevention of Maladjustment." Among the speakers are Stanley Estes, of Harvard University, Bela Mittelman, of New York University, David Rapaport, of the Austen Riggs Foundation, Fritz Redl, of Wayne University, and Wendell Johnson, of the University of Iowa.

The Physics and Chemistry of High Temperatures and Pressures will be the subject of a one-day meeting of research workers, sponsored by the Office of Naval Research and the Research Institute of Temple University, to be held April 25 at the Dental-Pharmacy Building, Temple University, Philadelphia. A demonstration of an experimental method for producing temperatures above 5000° F will be made.

A conference on the genetics of heterosis and its applications to plant and animal breeding is to be held June 13–July 14 at Iowa State College. Nearly 30 men, representing some 20 institutions, who have contributed to present knowledge of this subject will lecture and hold conference discussions on various aspects of heterosis. Most of these speakers will remain to participate in discussions led by others. Students wishing academic credit toward advanced degrees should register for the first half of the regular summer session and be prepared to pass an examination at the end of the conference. During the last two weeks a Methods Workshop will be held as a supporting laboratory on problem analysis of data most frequently occurring in animal breeding experiments. For further information write the Genetics Department, Curtiss Hall, Iowa State College, Ames, Iowa.

A technical conference on air pollution will be held May 3–5 at the Wardman Park Hotel, Washington, D. C., sponsored by the Bureau of Mines, Public Health Service, Department of Commerce, Army and Navy Medical Departments, Atomic Energy Commission, Department of Agriculture, and Department of Defense. Approximately 80 scientific papers will be presented, a number of them dealing with the suspected effect of smog on cancer and respira-

tory diseases. Chairman of the health panel is James G. Townsend, chief of industrial hygiene, Public Health Service.

The American Physical Society will hold its 300th meeting in Mexico City, June 21–24. A symposium on cosmic rays will take place June 22. Titles and abstracts of all papers should be received by Karl K. Darrow, Secretary, American Physical Society, Columbia University, New York 27, not later than *May 1*.

The Origin and Evolution of Man will be the topic of the 15th Cold Spring Harbor Symposium on Quantitative Biology, to be held June 9–17. Topics to be discussed include population as a unit of study, origin of the human stock, classification of fossil men, genetic analysis of racial traits, race concept and human races, constitution, and perspectives of future research. Those from abroad who will take part in the program are A. E. Mourant and R. R. Race, from Great Britain, Jan A. Böök, Bertil Lundman, and Torsten Sjögren, of Sweden, Tage Kemp, of Denmark, and A. Buzzati-Traverso, of Italy. Attendance will be restricted to about 100, due to space limitations. For programs and further information, address the Biological Laboratory, Cold Spring Harbor, New York.

The Society for Applied Spectroscopy will hold its fifth annual meeting May 26–27 at the Socony-Vacuum Training Center, 63 Park Row, New York City. The program will include a symposium on spectroscopic sources and an exhibit of spectrographic equipment, in addition to a variety of papers on subjects related to applied spectroscopy.

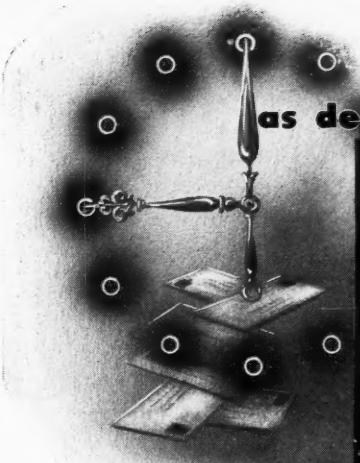
A symposium on anomalies in reaction kinetics will be held at the University of Minnesota, June 19–21 under the joint sponsorship of the Division of Physical and Inorganic Chemistry and the Minnesota Section of the American Chemical Society. The meeting is under the general direction of M. Burton, of the University of Notre Dame. Topics to be discussed at the several sessions and the respective discussion leaders are as follows: June 19, The Activated Complex, *H. M. Hulburt*, Catholic University of America, and Reactions in Solution, *M. Kilpatrick*, Illinois Institute of Technology; June 20, Free Radicals, *O. K. Rice*, University of North Carolina; June 21, Surface Reactions, *A. Farkos*, Allied Chemical and Dye Corporation. Approximately 30 invited papers will be presented during the meetings. Registration blanks and forms for hotel reservations will be published in *Chemical and Engineering News* in the near future.

Scientists planning to attend meetings abroad this Summer would do well to consult Youth Argosy, Northfield, Massachusetts, about air or ship transportation. Youth Argosy is a nonprofit organization facilitating low cost educational travel abroad. Planes are chartered DC-4's, carrying 50 passengers. Round trip plane passage to Luxemstill available for planes to and from New York and Luxembourg. Reservations are also possible with Youth Argosy on a 9-day steamship sailing from Montreal to Cherbourg, round trip $275 and up. Eastbound sailings are May 31, June 26, and July 22; westbound sailings, August 3 and 29 and September 24. Flight and sailing dates will permit attendance at almost any of the Summer Congresses, which include: July 1–15 *Eighth International Congress of Agricultural Industries*, Brussels; July 2–6 *International Microchemical Congress*, Graz, Austria; July 7–11, *International Union of Biological Sciences*, Copenhagen; July 12–20, *Seventh International Botanical Congress*, Stockholm; August 15–18, *16th International Physiological Congress*, Copenhagen.

A Veterinary Public Health Section has been created by the Pan American Sanitary Bureau, regional office of the World Health Organization, to promote national programs in aspects of diseases transmissible from animals to man, to coordinate the international phases of such programs, and to act as a clearinghouse for information. The first programs will be concerned with the control of rabies, brucellosis, and hydatid disease. Benjamin D. Blood, chief of the new section, is now spending three months in South America to work out, through mass treatment, public education, and special study projects, a campaign against hydatidosis in Brazil, Uruguay, Argentina, Bolivia, and Chile. An international campaign for rabies control has been inaugurated along the U. S.-Mexican border, and technicians from Mexico have studied the latest methods developed by the U. S. Public Health Service for control and diagnosis of the disease. Special studies on brucellosis are now being made, and the Third Inter-American Brucellosis Congress, jointly sponsored by the Brucellosis Committee of the National Research Council and the PASB, will be held in Washington, D. C., in November.

A ***Chart of the Nuclides*** (the name given to different kinds of nuclei whether they are of the same or different elements) has been prepared at the Knolls Atomic Power Laboratory of the General Electric Company. This chart is a revision of the *Chart of The Isotopes*, originally issued in 1948. Copies of the new edition and its accompanying explanatory booklet are being distributed to laboratories, schools, and colleges, and will also be sent to individuals on request to Department 6-221, General Electric Company, Schenectady 5, New York.

A new organization, **The Israel Institute of Applied Social Research,** representing an expansion of the institute's public opinion research, has been set up to conduct studies of a sociological and socio-psychological nature, including projects accepted from government departments and civic bodies, as well as market research and experiments in survey techniques. The institute, headed by Louis Guttman, formerly of Cornell University, will also take part in joint projects with foreign scientific organizations. The first issue of the quarterly bulletin, *What Israel Thinks*, summarizing in English reports of the institute's studies, was published this spring. Communications should be addressed to the Israel Institute of Applied Social Research, Sergei Building, Melisande Way, Jerusalem, Israel.



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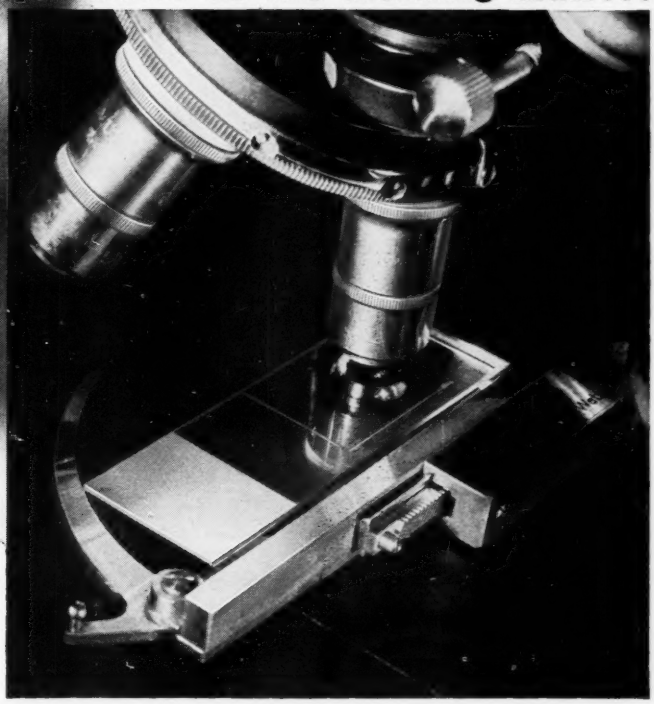

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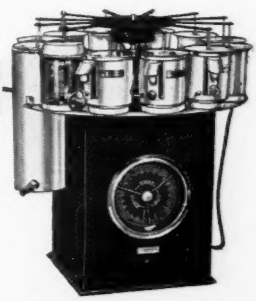

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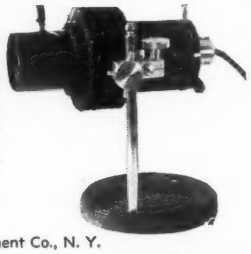

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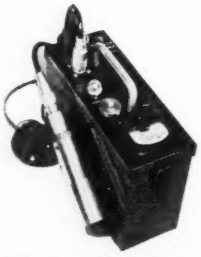

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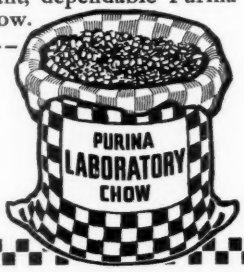

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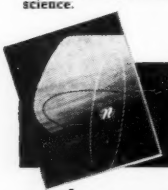

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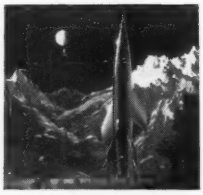

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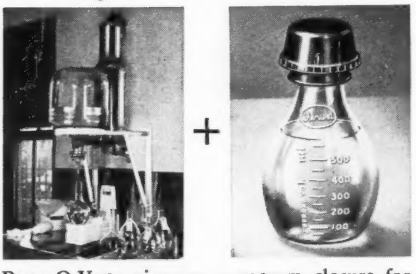

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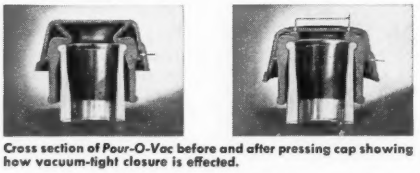

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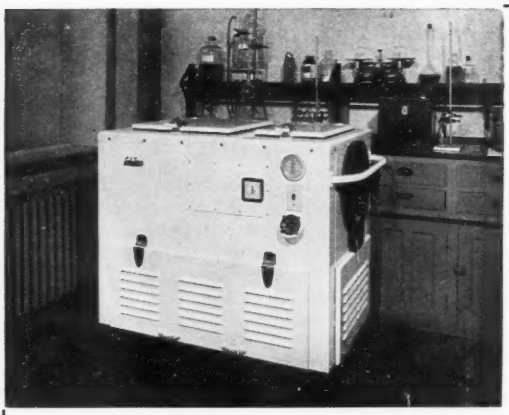

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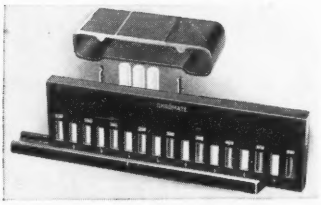

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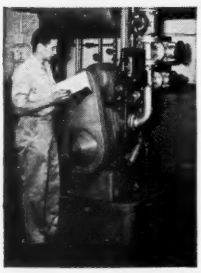

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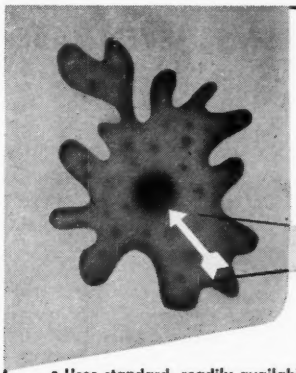

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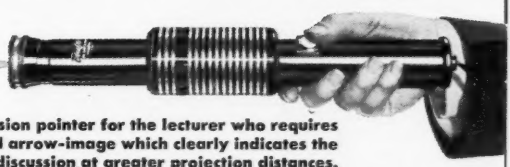

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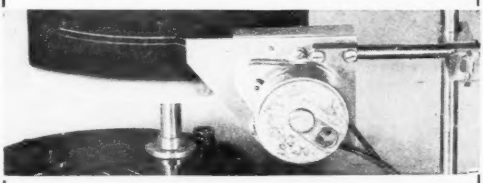

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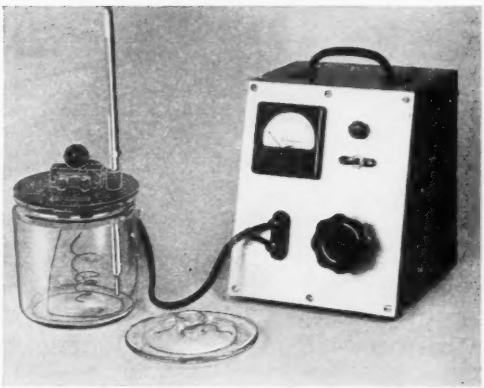

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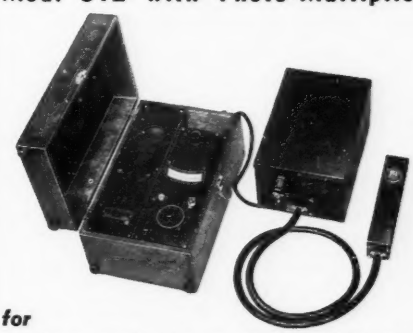

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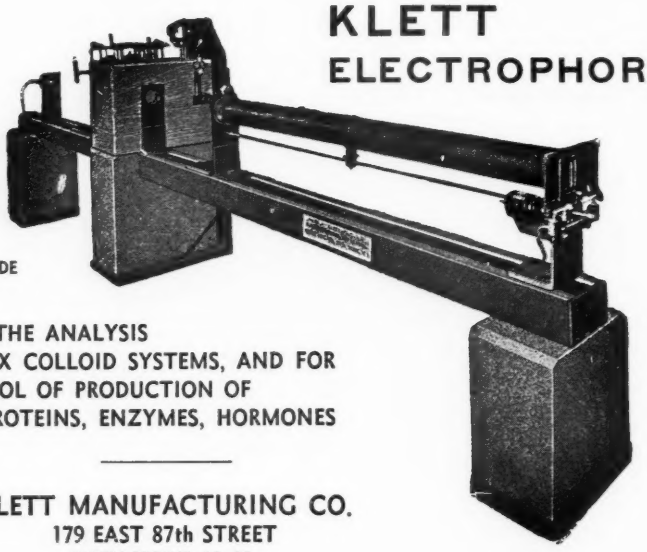

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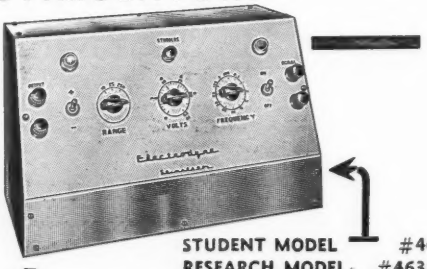

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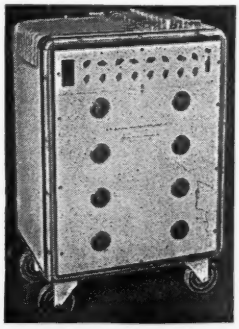

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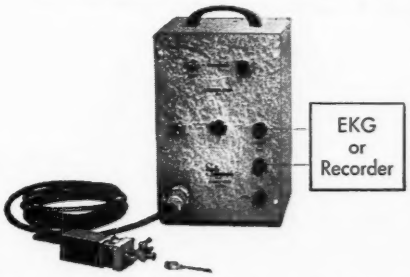

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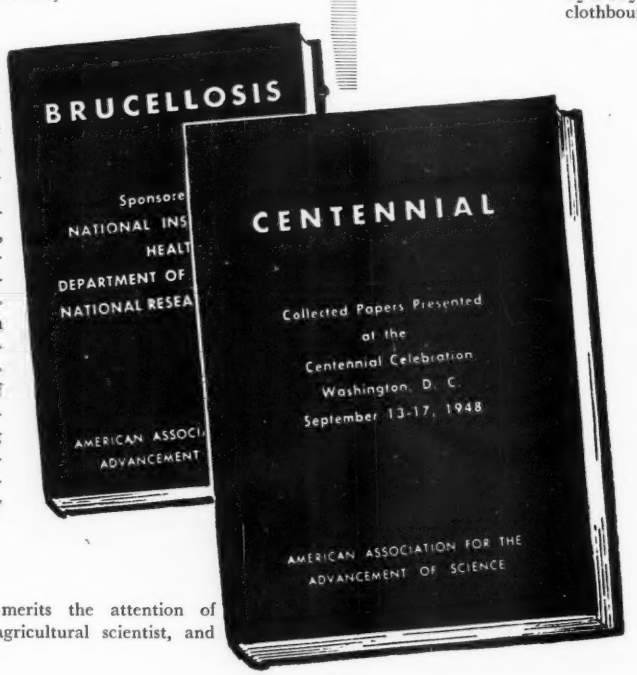

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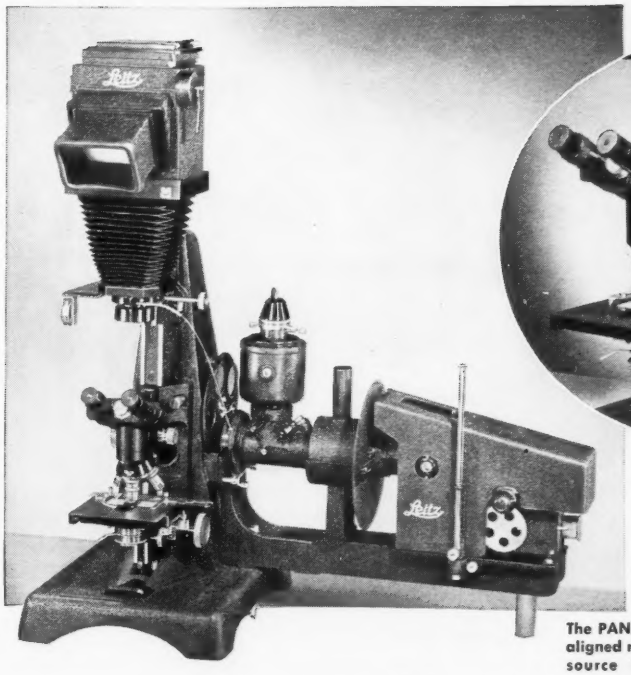

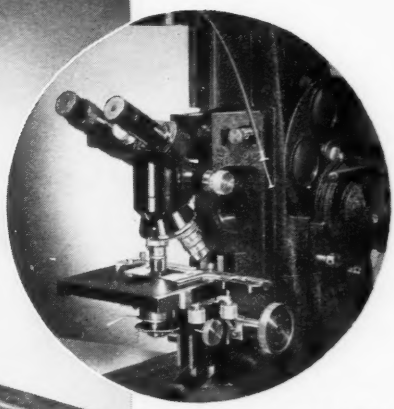

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